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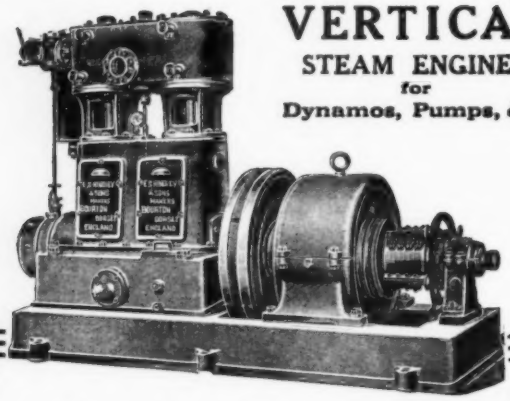

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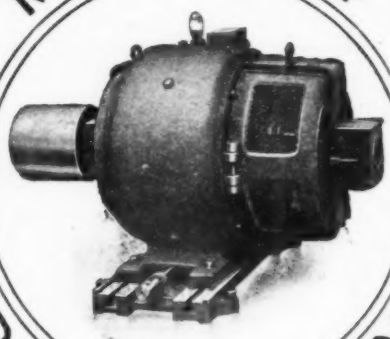

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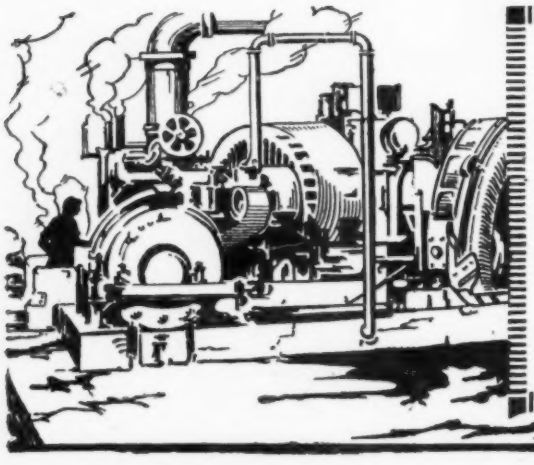

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Electrical Review

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The Engineering Industry.

IT was most fitting that there should be a public celebration, such as was held by the British Engineers' Association at the Hotel Cecil on Wednesday last week, to mark the successful organisation of the exhibit for which that Association has been responsible in the Palace of Engineering at Wembley. The Association and its director, Mr. Bremner, deserve every praise for what they have accomplished in bringing together such a magnificent collection of shipbuilding, marine, mechanical, and general engineering products, but Mr. Bremner did not hesitate to give prominence to the fact that his Association was responsible for only a part of the Palace of Engineering display, and we are sure that readers of these pages recognise quite well that the "Electrical and Allied Engineering" part of the Hall is crammed with a magnificent display second to none in its representative character, and that the B.E.A.M.A. has earned full credit and praise for having achieved at Wembley what is perhaps one of the finest pieces of work for electrical engineering and trade, for which it has been directly responsible, ever since it was formed.

With this prefatory comment we may proceed to state some reflections which more or less naturally arise out of such a celebration, for the finest exhibition which British electrical and other departments of engineering have ever brought together takes place when things are not as rosy as they might and should be. Indeed, in the thoughts of the past week, it has been impossible to keep in separate compartments of the brain such matters as the Exhibition, the Budget, and engineering wage and trade problems.

Sir James Stevenson, recovering from the nightmare of his great task, is so impressed with the wonderful engineering display which forms so large a part of his complete work, and he remembers so well the part that engineering industry played in the war, that he

at any rate has no qualms for the future of the Association that held the celebration. But Mr. E. W. Petter, the president of the B.E.A., and others who are daily in the thick of engineering affairs have shown that the display at Wembley has been paid for out of our poverty rather than out of our prosperity, and Lord Weir has described the achievements in the Palace of Engineering as "a national gesture and in no sense a reflection of any degree of true prosperity."

The position of our engineering industries at the moment is one of unquestioned difficulty. Its spokesmen, whether as chairmen of particular companies or as representative experts in engineering organisation, have made this fact clear at many recent gatherings.

Britain was the original Home of the Engineering industry of the world, and while to-day her engineering designers and producers yield pride of place to none in point of excellence or in the spirit of enterprise, it is the fact that other great nations have larger engineering industries and, owing to our handicaps, we have to seriously reckon with them in the markets at Home and abroad—particularly the latter. For some time past there has been a slump here, and skilled workers have found their way across the Atlantic in large numbers because unemployment and low wages in the land of their birth have induced them so to do. The figures quoted by Mr. G. N. Barnes on Saturday last at the festival dinner of the London Association of Foremen Engineers show that between 30,000 and 40,000 mechanics in this country are now out of work, and when it is remembered that there is no better operative mechanic than our own, it is deeply regrettable that after we have fully trained such men they are obliged to pass over to foreign countries and so strengthen our competitors!

It is to be hoped that the abolition of the final sixpence of the Corporation Profits Tax, which so long as it remained was both an immediate burden and a continuing menace, will do something to stimulate industrial confidence and promote greater activity by encouraging the investment of capital and by slightly reducing production costs; but the proposed non-renewal of the McKenna duties in August threatens to increase unemployment of skilled labour in one important department of the engineering trades, so that, in the opinion of many authorities whose views on a practical question have been sought, what is given with one hand may be more than taken away with the other. It is deplorable that anything should be done which may weaken our skilled labour position at a time when the world engineering demand and possibilities are so enormous, and hopes are entertained that Parliament may yet reshape Budget proposals.

As our readers well know, the engineering unions have put forward wage-advance demands, and nobody realises better than the employers the unfairness of a situation which compels engineering workers to labour for a low wage while other classes of workers—those in the building trades for example—are to have guarantees sheltering them over a period of 15 years. The great question is: what can the industry stand in the way of wage advances—in the presence of the prevailing conditions here and abroad—without driving away more business and creating further unemployment? It is understood that the Amalgamated Engineering Union and five other engineering unions have lodged an application for an advance of 20s. per week. It is impossible to separate the matter thus raised from the present position of the industry.

Lord Weir asked, in his speech last week: "Is immediate social reform to be regarded as of more importance to the nation than a healthy position in the producing industries? Is it for the ultimate national good that a bricklayer should work 44 hours a week at high wages and have his employment guaranteed to him for 15 years by the State while the skilled engineering workers are only partially employed at 47 hours with low wage rates?"

Employers in the engineering trade hope for the withdrawal or deferring of the above wage demand until the industry has had time to recover and the period of ruinous prices passes away. They issued an invitation, as our readers are aware, to the various unions to meet in conference with them to see whether some means could not be devised for obviating disputes, and it is satisfactory to learn that the invitation has been accepted and that proceedings will commence on May 14th. We have no doubt that good will result from this conference if it is entered into in the right spirit and with determination, but, as Lord Weir pointed out, it is the fact that prosperity does not lie in the hands of the industrialists alone. In so far as they have power to influence revival, their great and costly demonstration and effort at Wembley afford some evidence of the length to which they are going to encourage it.

What is required is a national recognition of the economic changes which are affecting our export industries and an understanding of some things that are required if we are to regain prosperity. One measure essential to the proper understanding of the subject by the nation at large may be a fully considered and fairly stated joint memorandum by employers and employed in the industry. It is pre-eminently desirable that these two parties should arrive at a common agreement, and we trust they may find it possible. It will be a sign of that goodwill which is so important if we are to unite to avert disaster. Only a most searching inquiry, and the disclosure of necessary information thereat, can meet the case, and if, after that has taken place, the true facts are revealed to the Government, and the Government recognising the needs of the nation, as stated by such a representative conference, passes these true facts on to the population, it will become obvious to all that our industrial and social policies must be linked up.

Mr. E. W. Petter,. who at the British Engineers' luncheon made the suggestion for the setting up of a Royal Commission to report to the Government on national industrial policy, received so many letters as the result of the speech that he has since outlined the suggested scope of the inquiry in *The Times*. It is as follows:—

"The present position of the manufacturing industries of the country in relation to—

(1) Cost of Production.
  1. Relation of cost of production to:—(*a*) Wages and hours worked; (*b*) cost of raw materials; (*c*) quantity of output; (*d*) local and Imperial taxation.
  2. Number of employés engaged per unit of manufactured product.
  3. Weekly wages, rate of and hours worked by skilled operatives, male and female.
  4. Earned wages—maximum, minimum, average.
  5. Ratio of wages paid to:—(*a*) Unit of output; (*b*) sales turnover; (*c*) profit.

(2) Marketing of Production.
  1. Extent and source of competition in:—
  (i.) Home market.
  (ii.) Export market—(*a*) British Dominions; (*b*) foreign countries.
  2. Effect of the McKenna tariffs and Safeguarding of Industries Act on industries concerned.

(3) Relations of Employers and Employés.
  Provision for reconciling differences and avoiding stoppages arising out of the same.

In all the above, comparison with the conditions of 1913 would be extremely valuable."

Without some clear understanding of the influences that are at work, we may drift along until some of our great export industries reach the same hopeless position as that of British agriculture.

What Lord Weir and others are asking the nation to investigate is this: Is the present slump merely one of abnormal duration or are we faced with a new situation in the British export industries, brought about by the influence of definite changes in our export system, which, without some adjustment, may render our present difficulties permanent? We feel, with others, that an inquiry of this kind, conducted with a genuine desire to make a non-partisan investigation and statement, is likely to bring out the true facts and may do a world of good—it certainly cannot do harm. The suggestion for a Royal Commission is criticised by some authorities who know only too well that matters are delayed and shelved; others consider that the scope of the inquiry is too wide. Our main concern here is that for immediate complete inquiry regarding the engineering industry.

Exhibition Visits.

THERE are in and around London thousands of employés in the offices of electrical and other engineering concerns who are glued to their stools doing commercial and clerical work from Monday morning to Saturday midday with little relief from the monotonous grind. Large numbers of them never see the manufactures turned out in the works, or the goods in which their employers trade. If the works are near at hand their chances of coming into actual touch with, and therefore becoming keenly interested in, the real live finished product, are better. One might by a stretch of the imagination almost believe that for the next five or six months the works and the showrooms have been brought to our very doors; certainly nobody within easy reach of Wembley need be deprived of the benefit of close observation of, and association with, practically the whole range of British electrical and engineering machinery and apparatus, electric supply applications and demonstrations, &c. It seems to us that the advantages that are likely to accrue to men (and women) of the class here specially mentioned from half a dozen hours in the Palace of Engineering are so excellent that the opportunity need only be mentioned for the suggestion to be adopted. In half a dozen hours such staff can obtain just that new and general knowledge of the industry and trade with which they are identifying themselves that will give a new interest to their daily occupation. Technical students and engineers will be so impressed with the display that they will wish they could live there all the time, but if firms can release their office and warehouse employés *in the daytime* for a free visit to see the technical and industrial exhibits they will almost certainly feel the benefit in their businesses of a new and intelligent interest and increased efficiency in the work carried on amid estimating duties, correspondence dictation, clicking typewriters, account rendering, and such-like details of office life.

The Trade of Holland.

HOLLAND imported last year electrical machinery and apparatus to the value of nearly 17,000,000 florins (about £1,420,000), of which Great Britain's contribution was only just 1,000,000 florins (£83,400). At the same time she imported electric cable to the value of about 6,000,000 florins (£50,000), of which nearly 80 per cent. was supplied by Germany. Details regarding Holland's electrical trade are published in this issue.

Britain's share in this trade seems deplorably small, and the prospect of augmenting it depends mainly upon the trend of German prices. If industry in Germany is in future to be made to bear the same burden of taxation as it labours under in Britain, it appears likely that the prices of her products will remain more nearly at international level. It is improbable that Germany will again be able or allowed to resort to "valuta" dumping. On the other hand, there is little doubt that the cost of labour there is relatively low, and is tending downwards. Yet, on balance, there are better chances for Britain to compete with German electrical manufacturers than there were when German export trade was so powerfully aided by the falling mark.

The French Electrical Industry.

THE movement in favour of the more general use of electrical domestic apparatus is making considerable headway in France. In the east, near the Alps, where power is relatively cheap, people are naturally more advanced than in the west. In another twenty years, when the general linking-up of power units in the Alps, in the coal-mining area, and in the Paris district is completed, the attitude of the public may be different. It is not so very long ago that nine-tenths of the domestic electrical appliances used were imported, as was also much of the industrial electrical plant. Now France is an exporting country, and her exports exceed her imports of electrical apparatus by many millions of francs yearly. French firms now make electrical apparatus for heating and cooking, electric irons, hair curlers, sewing machine motors, and vacuum cleaners for domestic service; also driers, boilers, &c., for industrial purposes. A French firm has just succeeded in selling an electric furnace to Norwegians in the face of Swiss and Italian competition. More than a million electric irons are now in use in France; on the other hand, the French are turning out 20,000 vacuum cleaners yearly. Six or seven years ago only American vacuum cleaners were on the market. The annual report of the Union des Syndicats de l'Electricité states that the company's foreign trade in electrical plant was very satisfactory in 1923. In terms of francs the exports amounted to 211 millions in 1921, and exceeded the corresponding imports by 48 millions; the exports were at the same figure—211 millions—in 1922, and were greater by 93 millions than the imports. The figures given by the Union for 1923 only relate to the eleven months ended with November, and for this period the exports reached a value of 250 millions of francs, while as the imports amounted to 134 millions, the surplus of exports over imports comes to 116 millions of francs for the eleven months. It is considered that these highly favourable results indicate not only great activity on the part of the manufacturing works, but also the growing popularity of French products abroad. Perhaps they also indicate a much greater interest than formerly in the electrical export trade activity of France. It is added that all the electrical industries have absorbed new capital amounting to 764,000,000 fr.

Supplemental Heating.

WHILST in many industrial operations it is a sound commercial proposition to use electricity alone for heating, there are cases in which it is more economical to adopt ordinary methods. An example is found in the annealing of malleable castings. Success in the production of malleable castings depends upon correct annealing; many foundries can produce excellent work up to the point of annealing, and then fail. This, presumably, is because the annealing is not carried out in a scientific way. Some foundry managers regard it as quite sufficient to heat the castings to a temperature of, approximately, 800 deg. Cent., and then allow them to cool, but in reality annealing, like any other form of heat treatment, is a delicate process, and, if improperly done, may actually be harmful in its effects.

There is no greater authority on malleable casting than Prof. Enrique Touceda, and what he says about the electric heating of annealing ovens is worth consideration. As the result of experiments, he formed the opinion that electricity was invaluable for supplying supplementary heat at certain times. In operation, the oven and its contents are heated in the ordinary manner by coal, and the firing is continued during the period for which the castings are to be held at constant temperature, but is so regulated that the temperature produced through this means and during this period is some 83 degs. Cent. lower than required, the deficiency being supplied by electricity.

Professor Touceda believes that, in the future, electric heat will be used in the oven to supplement carbonaceous fuel of any character. By means of an electric current, controlled by a potentiometer, the temperature can be maintained practically constant while the castings are being soaked, and the rate of cooling can be controlled with exactness by means of the same agency without any attention on the part of the heat treater. Annealing ovens are notoriously wasteful, and it appears as though the combined heating by coal and electricity may prove both economical and effective.

Boiler-Room Practice.

Furnace Efficiency, Excess Air, and the Critical Point of Combustion.

By JOHN BRUCE, A.M.I.E.E.

THE aim of every conscientious and enthusiastic engineer-in-charge of steam generating equipment is to reduce and maintain the cost of steam production at a certain minimum value, consistent with efficiency, capacity, and reliability of service. Considering the question from a broad point of view, and with coal at a given price per ton, there are two ways by which this end can be attained. These are: increasing the operating efficiency and obtaining higher capacity from the boiler-room equipment.

The bulk of the electrical energy utilised in this country is produced by steam, generated by heat from the combustion of coal, and it is intended to confine this article to a discussion of the factors governing air supply, which directly influence the performance of coal-consuming equipment. The modern boiler unit for the generation of steam from the combustion of coal consists of a furnace, boiler, superheater, and economiser, and the performance of the composite unit can be readily expressed in terms of certain factors over which the operating engineer has, or should have, perfect control.

Assuming that the correct quality of coal is being used, and the equipment maintained in first-class condition, the performance of the furnace is directly influenced by the air supply, which in turn is influenced by two easily controlled variables. These variable factors are: (1) Fire-bed thickness and grate speed in the case of travelling grate stokers; and (2) draught pressure drop through the fire-bed. In the later designs of automatic stoker plant, whether of the chain grate, travelling grate, or retort type, these furnace variables can be perfectly and independently regulated in any part of the furnace.

The function of the boiler is the absorption of the heat liberated in the furnace, and the variables governing the performance of the boiler as a unit for the absorption of heat are: (1) Temperature; (2) velocity of gases; (3) condition of external and internal boiler surfaces.

A high temperature gradient is necessary for efficient heat transfer, therefore temperature is the predominant factor, influencing as it does all three modes of heat transmission, radiation, convection, and conduction. Since temperature is directly dependent upon furnace performance, the efficiency, and to a certain extent the capacity, of the boiler unit are, practically, entirely influenced by the two variable factors governing furnace performance. As already stated, these are fire-bed thickness and air supply.

To digress for a moment: In the past it has been customary to express boiler unit efficiency values as the ratio of the heat absorbed by the boiler water and steam to that available for absorption, liberated by the complete combustion of unit weight of coal, the total losses involved in the process being charged against the complete boiler unit. There is now a tendency, however, to consider the boiler and furnace as separate and distinct units, and to express the boiler efficiency as the ratio of the heat absorbed to the heat available for absorption, arbitrarily charging against the furnace, in addition to the recognised furnace losses, all other losses such as radiation, air infiltration, and the latent heat in the water vapour produced from the combustion of the hydrogen and the evaporation of the moisture content of the coal. Boiler efficiency, as distinct from furnace efficiency, may therefore be expressed as:—

$$B\eta = \frac{E \times (H - h)}{[E \times (H - h)] + [\cdot 24\ w\ (T_2 - T_1)]} \times 100$$

where E = actual evaporation per lb. of coal, and $(H-h)$ = heat content per lb. of steam, above feed-water inlet temperature.

$\cdot 24\ w\ (T_2 - T_1)$ = sensible heat in flue gases per lb. of coal consumed.

Furnace efficiency can be defined as the ratio of the heat available for absorption by the boiler, superheater, and economiser to the potential heat in the coal, and can be expressed as:—

$$F\eta = \frac{[E \times (H - h)] + [\cdot 24\ w\ (T_2 - T_1)]}{C} \times 100$$

where C = calorific value, B.th.u. per lb. of coal as fired, and the other factors have the same value as in the previous equation.

The overall efficiency of the unit is then the product of the foregoing equations, *i.e.*:—

$$O\eta = B\eta \times F\eta.$$

Furnace losses are more or less interdependent, and the only means by which furnace efficiency, and consequently fuel economy, can be obtained and maintained is by determining the relation between the various items which constitute the losses, *e.g.*, excess air, unburned gases, high temperature of escaping flue gases, unburned carbon in ash, &c. The process of combustion in the ordinary steam boiler furnace may be defined as the rapid oxidation of the combustible constituents of coal, resulting in the evolution and liberation of light and heat, thus establishing a temperature difference and permitting the utilisation of the heat "head" in useful work.

That part of the furnace designated the combustion space is simply a chamber designed to retain the gaseous products of combustion until such combustion is completed. It is frequently stated that a definite relation should exist between the volumetric capacity of the combustion chamber and the amount of coal consumed per square foot of grate surface in a given time. While this has a large bearing on the matter, mere volume alone is not all there is to it. The combustion chamber must be provided with the temperature necessary for the completion of the combustion reactions; further, it must ensure the intimate intermingling of the gases with the necessary secondary air to support combustion, and the amount of such air, above that required for perfect combustion, must be kept to a minimum. Last, a point of vital importance, it must provide the time element, or duration of contact, between air and combustible gases necessary for the complete oxidation of the latter. Therefore since volume is the product of three dimensions of the furnace, and since the flame or gas path is along one dimension only, the efficiency of combustion is as much a function of length of flame path as it is of combustion chamber volume. In addition, the effective combustion chamber volume is further governed by factors involving maintenance of side walls and ignition or deflecting arches, the useful life of which is determined by the composition of the brick, method of setting, and the temperature to which it is subjected in practice.

It will not be altogether out of place to consider at this point the difference in certain factors governing the process of combustion on the grate or fire-bed and in the combustion chamber. The coke, or fixed carbon, being consumed on the grate, is held more or less in place until combustion is complete, the rate of combustion being maintained by the scrubbing action of the oxygen and the high temperature prevalent in the fire-bed. The conditions in the combustion chamber, though somewhat similar, are more difficult of fulfilment. The exact composition of the hydrocarbons when first distilled from a coal at the different temperatures is not known, as, owing to the fact that they are of a very unstable nature and break down readily under the influence of heat, the

collection of samples for analysis is a difficult matter. The heavier series are driven off in the form of a semi-liquid or solid tar, the lighter series being given off in a gaseous state. The heavy hydrocarbons, under the influence of heat, break down into hydrogen, carbon, oxygen, hydrocarbons of the CH_4 series, and lighter unsaturated hydrocarbons. The carbon is precipitated in the form of soot particles, which, being in a state of incandescence, give flame its luminous appearance. The combustion of this soot or carbon is an entirely different proposition to the combustion of the fixed carbon on the grate. The complete oxidation of the soot particles released from the hydrocarbons necessitates a supply of oxygen in the combustion chamber sufficient to ensure that every atom in a soot particle will be satisfied. Further, this oxygen must be brought into contact with the carbon atoms in a temperature sufficiently high to sustain combustion, and sufficient time must be provided to complete the oxidation. The carbon particles do not have the benefit of violent mechanical contact with a supply of oxygen, and not only are they already on their way to zones of lower temperature at the instant of their formation, but their formation takes place in an atmosphere already deprived of most of its oxygen. With a modern unit, however, the best designs ensure effective mixing and a minimum of interference from large volumes of inert and non-combustible gases. The temperatures in the combustion chamber are, as a rule, sufficiently high to ensure ignition, but in the majority of cases the time element is insufficient, and oxidation of the volatile carbon is incomplete.

It is understood, of course, that (to take a unit weight) for every pound of coal consumed in a furnace, a definite weight of oxygen, and therefore air, is necessary for its complete combustion. Perfect combustion results when complete oxidation of the combustible elements takes place, when supplied with just that amount of oxygen theoretically necessary for combustion. This, of course, is impossible of attainment with even the most efficient design of commercial boiler furnace, and at the present state of the art, all that the furnace operator can do is to maintain the correct combination of conditions to ensure complete combustion. Complete combustion may be defined as the oxidation of all the combustible constituents of the coal, but does not mean that all the oxygen supplied has been utilised.

The effect of supplying a greater quantity of oxygen than is theoretically required for the combustion of a coal results in losses that will presently be discussed. It will be obvious, however, from what has been said, that the criterion of efficient combustion of any coal will be the ratio of the amount of air theoretically required to the amount of air actually supplied for the process of complete combustion.

Considerable confusion exists in connection with the terms and statements relating to fuel and combustion questions. The word "coal" is continually used, even in authoritative text-books, without any qualifying statement as to whether the basis taken is the combustible, dry coal, or the coal as delivered or as fired. It is frequently stated that one pound of average steam-raising bituminous coal, theoretically requires approximately 11.5 lb. of air for combustion. Such a statement is very misleading to practical engineers in charge of steam generating equipment, where the coal, as weighed and delivered to the furnaces, is the mineral containing combustible, moisture, ash, &c.

In academic work it may be convenient to neglect moisture and ash, but in everyday boiler-room practice these constituents have unfortunately got to be handled and taken into consideration, and the boiler-room engineer should train himself to consider all questions relating to combustion only on a basis of coal as fired. The theoretical amount of air required for the combustion of a given coal can be readily computed from a knowledge of its ultimate analysis, and here again in boiler-room work, such an analysis, if reported on the basis of coal "as fired," will save a considerable amount of conversion of coal weights, &c. For example, consider a bituminous coal having the following ultimate analysis corrected to a basis "as fired" or "as delivered":—

Carbon	... ...	65.00 per cent.
Hydrogen	...	4.50 per cent.
Sulphur	...	1.00 per cent.
Oxygen	... ...	6.00 per cent.
Nitrogen	...	2.00 per cent.
Ash	... ...	11.50 per cent.
Moisture	...	10.00 per cent.

The amount of air in lb. theoretically necessary for combustion per lb. of coal of the above composition is:—

$$11{\cdot}52\,C + 34{\cdot}56\,(H - 0{\cdot}8) + 4{\cdot}32\,S.$$
$$= (11{\cdot}52 \times 0{\cdot}65) + [34{\cdot}56 \times (0{\cdot}045 - 0{\cdot}06/8)] + (4{\cdot}32 \times 0{\cdot}01)$$
$$= 8{\cdot}83 \text{ lb. of air per lb. of coal.}$$

The theoretical air necessary for the combustion of the same coal, based on one lb. of combustible, will have an entirely different value. Converting the necessary items in the above analysis to a combustible basis:—

Carbon	... ...	93.19 per cent.
Available	hydrogen	5.38 per cent.
Sulphur	... ...	1.43 per cent.

Substituting these values in the previous equation (which it should be pointed out, being based on certain assumptions, is not strictly accurate), the value of the theoretical air becomes:—

12.64 lb. of air per lb. of combustible.

It will thus be understood that there is no direct relation between the weight of coal delivered to the boiler furnaces and the weight of air theoretically necessary for its combustion. The theoretical weight of air may vary, for the different qualities of coal, between limits of 6.5 lb. for the low grades to over 11.0 lb. for high-grade fuel containing a low percentage of ash and moisture. In the large power stations where the coal fed to the furnaces may vary greatly in quality and ash and moisture content in the course of possibly an hour, the greatest vigilance is necessary to maintain the correct conditions of air supply to suit the varying nature of the fuel. A fairly definite relation exists, however, between the theoretical air and the heat generated, and for the usual coal used for steam-raising purposes it will be found on analysis that approximately 7.5 lb. of air is theoretically required per 10,000 B.th.u. liberated. Therefore, in practice, the calorimetric determination will give a good idea of the air quantities involved. No definite rule can be laid down, however, for more confusion exists in the definition of the calorific value of a coal than in any other phase of combustion practice.

It is customary to see in manufacturers' catalogues, and often also in books of reference, tables and sets of curves purporting to show furnace losses corresponding to the different percentages of CO_2 present in the flue gases. While such figures and curves may be true for the class and quality of coal from which the data has been computed, they can only be true for that particular coal, and are not applicable in practice where fuel of a different quality is used and any degree of accuracy is desired in the determination of furnace losses.

The complete combustion of any coal results in the production of a definite percentage of CO_2, this percentage, as will be shown presently, being governed by the amount of excess air with which the coal has been consumed. The maximum percentage of CO_2 which would be produced by the perfect combustion of any coal is determined by its hydrogen and sulphur contents. The combustible constituents of coal are carbon, available hydrogen, and sulphur, the last having very little value as a fuel. Carbon burns to CO_2, hydrogen burns to H_2O, and sulphur burns to SO_2. By the usual methods of boiler-room gas analysis, only the product of combustion of carbon can be determined, with, of course, the inert nitrogen and uncombined oxygen and unconsumed gases; the products of hydrogen and sulphur are condensed by the water in the gas collecting and sampling apparatus, and do not enter into the analysis. The CO_2 determinations as made by the usual

Orsat or automatic absorption type of gas analysing apparatus therefore register the percentage volume of CO_2 in the dry flue gases. The maximum CO_2 that would be obtained can be easily calculated from the ultimate analysis of the particular coal. For example, consider the analysis of the fuel already referred to. The oxygen required for perfect combustion would be as follows:—

For carbon	0.65	× 2.66 =	1.729
,, available hydrogen ...	0.0375	× 8.00 =	.300
,, sulphur	0.01	× 1.00 =	.010
Total			= 2.039

As already stated, the products of the combustion of the hydrogen and sulphur condense and do not enter into the analysis. The proportion of the oxygen required to burn the carbon is therefore—

$$1.729/2.039 = 0.847$$

The percentage of the original oxygen in the air used in burning carbon to form CO_2 is then—

$$20.8 \times 0.847 = 17.62 \text{ per cent.}$$

And the maximum CO_2 expressed as percentage volume of the total gas residue is—

$$17.62/79.2 + 17.62 \times 100 = 18.19 \text{ per cent.}$$

With complete combustion of the average bituminous coals there is a definite relation between the percentage of carbon dioxide as registered by gas analysing apparatus, and the percentage of excess air admitted during the combustion of the coal. While this relation will vary with different hydrogen and sulphur contents, it is for all practical purposes of sufficient accuracy to be applicable as a guide to air conditions in the majority of cases, as the following examples will show. Assume three different coals having ultimate analyses as reported below:—

	Coal (*a*).	Coal (*b*).	Coal (*c*).
Carbon per cent.	75·00	70·00	65·00
Hydrogen ,, ...	3·50	4·50	4·00
Oxygen ,, ...	2·00	6·00	8·00
Nitrogen ,, ...	1·00	1·50	1·00
Sulphur ,, ...	1·00	1·50	0·50
Ash ,, ...	7·50	6·50	11·50
Moisture ,, ...	10·00	10·00	10·00
Totals ...	100·00	100·00	100·00

The calculations involved in the computation of air quantities for the combustion of a given coal and the estimation of data referring to combustion products and flue gas composition for varying amounts of excess air are, though simple, somewhat lengthy, and it will be sufficient if only coal (*a*) is considered in detail.

With perfect combustion the necessary oxygen and air quantities involved and the products of combustion will be as set out below:—

Chemical Symbol	Weight per lb. of Coal	Air and O_2 requirements lb.		Products of Perfect Combustion. Pounds per pound of Coal.				
	lb.	O_2	Air.	CO_2	O_2	N_2	H_2O	SO_2
C	·750	2·00	8·64	2·75	—	6·64	—	—
H_2	·035	·28	1·20	—	—	·92	·315	—
O_2	·020	—	—	—	·02	—	—	—
N_2	·010	—	—	—	—	·01	—	—
S	·010	·01	·043	—	—	0·03	—	·02
Ash	·075	—	—	—	—	—	—	—
Moisture	·100	—	—	—	—	—	·100	—
Totals	1·000	2·29	9·883	2·75	·02	7·603	·415	·02
Less O_2 in Coal and equivalent N_2		·02	·086	—	·02	·066	—	—
Totals ...		2·27	9·797	2·75	—	7·537	·415	·02

From the data so tabulated it will be seen that the theoretical amount of air necessary for perfect combustion is 9.797 lb. Each 20.00 per cent. of air in excess of this amount will result in an addition of 1.960 lb. of air, and for every 20.00 per cent. increase above the theoretical there will appear in the products of combustion:—

0.454 lb. of O_2
1.506 lb. of N_2.

The weight of the products of combustion for different increases in the amount of excess air will be:—

Symbol	Weight in lb. Products of Perfect Combustion	Weight of Products of Complete Combustion with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	2·750	2·750	2·750	2·750	2·750	2·750	2·750	2·750
O_2	—	·454	·908	1·362	1·816	2·270	2·724	3·178
N_2	7·537	9·043	10·549	12·055	13·561	15 067	16·573	18·079
H_2O	·415	·415	·415	·415	·415	·415	·415	·415
SO_2	·020	·020	·020	·020	·020	·020	·020	·020
Totals	10·722	12·682	14·642	16·602	18·562	20·522	22·482	24·442

These values, converted to a basis of percentage weight, give the following:—

Symbol	Percentage Weight Products of Perfect Combustion	Percentage Weight Products of Complete Combustion, with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	25·65	21·67	18·78	16·55	14·81	13·40	12·23	11·21
O_2	—	3·58	6·14	8·21	9·78	11·07	12·12	13·01
N_2	70·29	71·31	72·05	72·61	73·06	73·41	73·7	73·95
H_2O	3·87	3·28	2·84	2·51	2·24	2·02	1·85	1·70
SO_2	0·19	0·16	0·14	0·12	0·11	0·10	0·09	0·08
Totals	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Since gas analyses are on a basis of dry flue gases, the next step is the conversion of the percentage weights of the total products of combustion to a basis of percentage weight of the dry products of combustion. As already pointed, out, with complete combustion the constituents involved in a gas analysis are CO_2, O_2, and N_2. These values are shown below expressed as percentage weight of the dry products of combustion:—

Symbol	Percentage Weight Dry Products of Perfect Combustion	Percentage Weight Dry Products of Complete Combustion, with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	26·73	22·44	19·36	16·99	15·16	13·69	12·47	11·46
O_2	—	3·71	6·38	8·43	10·01	11·31	12·35	13·24
N_2	73·27	73·85	74·26	74·58	74·83	75·00	75·17	75·30

The values with which we are principally concerned are those showing the relation between the percentage of excess of air and the percentage volume of CO_2, as would with complete combustion be registered by gas analysing apparatus. These relations are shown set out below, and for purposes of comparison the similar stages in the computation of coals (*b*) and (*c*) are set down alongside:—

COAL (*a*).

Symbol	Percentage Volume Dry Products of Perfect Combustion	Percentage Volume Dry Products of Complete Combustion, with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	18·78	15·64	13·39	11·63	10·37	9·30	8·49	7·72
O	—	3·59	5·94	7·85	9·33	10·49	11·48	12·33
N_2	81·22	80·88	80·67	80·52	80·30	80·21	80·03	79·95

COAL (*b*).

Symbol	Percentage Volume Dry Products of Perfect Combustion	Percentage Volume Dry Products of Complete Combustion, with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	18·27	15·21	13·99	11·86	10·06	9·06	8·21	7·52
O_2	—	3·56	6·09	7·97	9·42	10·57	11·72	12·20
N_2	81·73	81·23	80·92	80·67	80·52	80·37	80·27	80·19

(COAL (*c*).

Symbol	Percentage Volume Dry Products of Perfect Combustion	Percentage Volume Dry Products of Complete Combustion, with various Percentages of Excess Air.						
		20·0 %	40·0 %	60·0 %	80·0 %	100·0 %	120·0 %	140·0 %
CO_2	18·69	15·50	13·23	11·57	10·28	9·21	8·39	7·68
O_2	—	3·55	6·19	7·96	9·44	10·60	11·52	12·28
N_2	81·31	80·95	80·58	80·47	80·28	80·19	80·09	80·04

(To be concluded.)

Trade Commissioner Home from Canada.—Mr. F. W. Field, who has for some years held the post of His Majesty's Trade Commissioner at Toronto and who has recently been appointed to the post of Senior Trade Commissioner in Canada, will be in attendance at the Department of Overseas Trade in London from May 12th to 31st. He will be pleased to interview British manufacturers and merchants interested in export trade with Canada. Subsequently he will visit the principal industrial centres of the United Kingdom. Applications for interviews in London should be made at once to the Comptroller-General, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, the reference T.G. 5282 being quoted in all cases.

Cleaning Dirty Insulators.

[Communicated.]

AN article on this subject appeared in the ELECTRICAL REVIEW for June 22nd, 1917, by the present writer, and the number of questions which it elicited gave evidence of widespread interest among telegraph, telephone, lighting, and power engineers.

The method described on that occasion has been in regular use during the intervening years, and it may, therefore, serve a useful purpose to submit particulars afresh of the materials used, the manner of cleansing, and to add a few practical observations which the past seven years' experience has taught in this connection.

In open country districts, insulators will retain their cleanliness indefinitely. The exception to this rule is along certain railway cuttings, where the escaping smoke from passing engines is intercepted by the telegraph wires rigged on poles on the bank or side of the slope, thus causing the insulators to become coated with a grimy deposit of inky blackness within five or six years' time. When the rising gradient of a railway line is severe the porcelain glaze becomes dirty at an earlier date.

Reasons similar to those mentioned are responsible for a lowering of the insulating value of aerial routes near railway bridges where terminal insulators are employed. Experience has shown that this form of leading-in insulator is apt to accumulate filth in the interstices and apertures to an unexpected degree. As is generally known these terminal cups are provided with porcelain screwed caps under which the cable conductor is joined to the line connection and a layer of insulation compound hermetically seals the upper part. It is below this point that trouble may be suspected, and occasional replacement will become desirable.

These may be regarded as abnormal cases. In every centre of industry—by reason of the smoke nuisance—the blacking of insulators proceeds apace, and calls for no special comment, unless it be in the nature of an inquiry as to how they may be cleaned economically and efficiently.

The illustration accompanying the present article (fig. 1) shows an insulator cleaning device, consisting of a double tank, brick lined on either side, and provided with a coal fire grate underneath. The tank nearest the chimney is three parts filled with water (roughly 24 gallons) together with an admixture of quebracho extract and caustic soda in the proportion of 3 lb. quebracho to 1 lb. caustic soda. A tank of this size will conveniently hold about 120 ordinary insulator cups. The latter should be allowed to remain in the slowly boiling liquid for a period of 20 minutes, after which they are transferred to the second tank, which is half filled with warm water. If the chemical action in the first tank has not entirely removed the dirt, a wet sponge cloth used in the second tank will easily complete the necessary transformation. The insulators are then rinsed in clear cold water, either in a bucket or under a tap, and left to dry prior to their being packed for a further period of usefulness.

When transferring insulators from the first to the second tank it is unnecessary to touch the liquid with the hand. A pair of 14-in. smithy tongs, or the equivalent, will be found quite effective for the purpose.

As soon as the cleaning process has been finished, the liquid in the first tank should be emptied and removed to a wooden tub with the object of using the residue on the next occasion. The strengthening of the liquid should, of course, receive due attention.

If there is a large number of insulators to be dealt with it is better to have two workmen on the job—one at each tank—and each man should be supplied with a leather apron.

During the past eleven years unskilled artisans have carried out work of this character, and the first injury of any description has yet to happen.

A note of warning should be sounded. There is a tendency for insulators to fracture if left too long in the heated liquid tank, or if suddenly plunged into cold water after heated immersion. Workmen should be warned to avoid either extreme. A cleansed insulator will occasionally reveal slight vein cracks due to a long period of service, and these insulators should be destroyed or utilised for short-distance, unimportant circuits. Where a service of steam is available a jet may be passed through the quebracho-caustic soda tank, in which case the process will only take half the time that would be required of a coal-burning fire. The use of steam, however, is apt to cause splashing, which is undesirable.

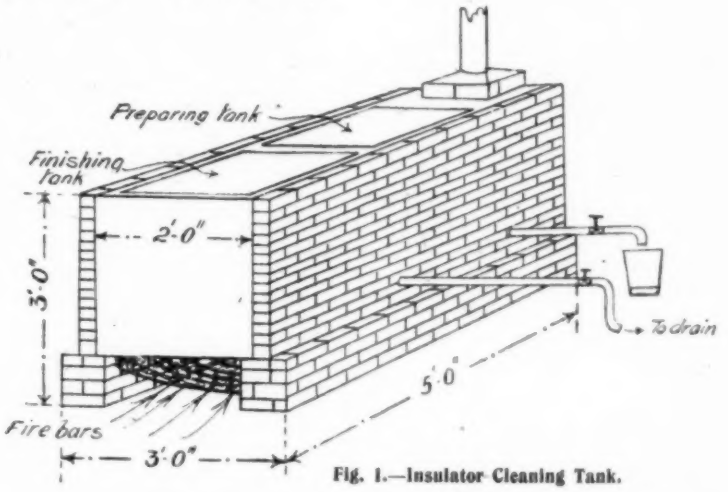

Fig. 1.—Insulator Cleaning Tank.

The properties of caustic soda are so well known as to render a description unnecessary, but the question has been often asked: "What is quebracho?" The word "quebracho" means "axe breaker!" and the extract made use of in an insulator cleaning plant is a product manufactured from the wood of the quebracho tree, which grows in South America, the principal port of shipment being Buenos Ayres. It will be readily understood how the tree has derived its name when it is explained that the wood is very hard, heavy, and brittle. In manufacture, the trees are cut down, freed from branches and hauled to the factory. There they are led to a cutting plate which cuts across the grain reducing the wood to a fine chip that is easily penetrated by water. The chipped wood is then placed in large extractors where it is boiled with water, and the weak liquor thus produced is concentrated to a thick extract containing about 50 per cent. water in evaporating pans working under a vacuum of about 20 in. This thick liquor is again evaporated under vacuum until it contains about 20 per cent. moisture. It is then run off into bags and allowed to solidify. In its natural state the quebracho tree contains about 20 per cent. extractive matter. Quebracho can be obtained from a Liverpool firm of which the Editors have particulars.

Whilst on the subject of insulator cleaning it will no doubt be of interest to quote Technical Instruction No.

13 of the Post Office Engineering Department, whose method is as follows:—

"When insulators are removed from the spindles to be cleaned the following method should be adopted: The insulators should be steeped in a bucket of hot water, in which 3½ lb. of soda has been placed. After immersion for some time they should be taken out of the bucket and rubbed inside and out with a diluted solution of hydrochloric acid (one of acid to four of water) applied by means of a woollen or worsted mop. The insulator should then be rinsed in a bucket of cold water and any dirt should be rubbed off with waste. Additional acid should be added to the acid solution as required. A bent wire should be used for holding the insulators while the acid is applied."

Other methods have been tried with varying success to clean dirty insulators, but the one first described in which quebracho extract and caustic soda are used may be said to represent, in the opinion of the writer, the survival of the fittest.

The Water-Power of Sweden and the Swedish Water-Power Association.

THE total water power of Sweden amounts to some 6,000,000 h.p., about 4,500,000 of which is owned by municipalities and private concerns, and about 1,500,000 is owned by the Swedish Government. The hydro-electric energy has been estimated at approximately 32,000,000,000 kWh per year. Slightly over 20 per cent. of the water power available has so far been harnessed. Of the 1,300,000 h.p. which has been developed about 1,000,000 is represented by municipal and private plants, and about 300,000 by Swedish State power stations. The present total production of energy amounts to about 3,000,000,000 kWh per year.

The principal State-owned power stations are:—Trollhattan (160,000 h.p.), Alfkarleby (65,000 h.p.), Porjus and Motala, and at present the Swedish Government is installing three low-head turbines of 10,000 h.p. each, working on a head of 21 ft. 6 in., at Lilla Edet.

Of Sweden's rural districts covering an area of nearly 10,000,000 acres, about 40 per cent. has been electrified by State, municipal, or private plants.

The most important of the municipal plants is Untraverket, owned by the city of Stockholm. This power station was completed in 1918, and has at present an output of 40,000 b.h.p., under a 46-ft. head. The plant is built for future increase to 50,000 b.h.p.

A great number of other towns have power stations of their own, but in many cases the municipalities enter as shareholders in power distributing concerns. A typical example is the South Swedish Power Co., which was formed in 1906, and distributes power in the southern provinces. Amongst the main shareholders in this company are the cities of Malmo, Lund, Landskrona, Helsingborg and Halmstad. The majority of the large power stations, however, are owned by industrial companies or groups of such companies.

The Swedish Water Power Association (Svenska Vattenkraftföreningen) was founded in 1909, to further a sound development of Sweden's abundant water-power resources. Amongst the members of the Association are some 300 individuals, about 120 business concerns, 12 corporations, and a number of foreign correspondents. During the past 14 years the Association has had numerous opportunities to serve its purpose successfully, and the most important of all was the active part taken by its representatives in the elaboration of the new Swedish water legislation. By means of frequent publications, at present numbering over 150, and general information work, the Association has from time to time given considerable support to the country's water-power industry. At the exhibition in Gothenburg last summer the Swedish Water-Power Association arranged an interesting exhibit illustrating Swedish municipal and private water-power industries, showing their development, and particularly the general power distribution provided for by those industries. To this end there were displayed in the exhibition hall models of the big municipal power plants with their transmission lines, the output during recent years from various plants, the electrification of different rural districts, and accessible water-power along certain important rivers were shown graphically. A great number of typical photographs of various power plants were also exhibited.

Ruining the Industry.

By R. W. W.

AMERICANS are supposed to worship the almighty dollar but it would appear that we Britons are fast becoming slaves to the almighty farthing.

"Take care of the pence and the pounds will take care of themselves" is, in a broad sense, a very sound doctrine, but taking it too literally may develop either the miser or the fool.

Our industry to-day is becoming rather foolish. The majority in it kneel at the shrine of price.

With thankfulness, let us admit there are still a few who are old-fashioned enough to consider quality, but that does not alter the fact that nine times out of ten 3d. per dozen on the prices of switches will decide the destination of the order.

Manufacturers, to live, must sell their goods and must make a profit. In these days of severe competition exorbitant profits are out of the question.

Try to sell a man motors or meters, cable or cut-outs, fires or fittings, and the first and apparently only consideration is: "What is your price?" This may be followed by: "Come down to so much and you can have the order."

Are we to believe then that buyers are childish enough to think that price-cutting can be continued indefinitely, and entirely at the expense of the manufacturer?

Is it not reasonable to recognise that within limits the more expensive article must be the better value?

I say within limits advisedly. Differences in methods, organisation, and the weight of overhead charges can and do cause small variations in prices of articles of exactly equal value.

Also it is possible for rings or combines to force prices to an artificial level, but the general fact is indisputable, and it is time to call a halt and see whither we are drifting.

If price and price alone is to decide business deals we may be sure there will always be manufacturers ready to meet the demand. Cheaper and nastier goods will be installed, and shoddy and slipshod will become our main characteristics.

The contractor will, of course, reply that he must buy in the cheapest market in order to live with his competitors. He may live for a time, but his reputation will not be enviable.

Strangely enough, those old-fashioned firms which believe in a good job at a good price, using good materials, still appear to jog along comfortably. In common with everyone else, they have felt the slump, but when trade improves they always seem to be the first to benefit.

If there is a moral here I would say it is this—when selling let us insist on talking quality, and when buying, try to remember that it is supremely difficult to get more than one's money's worth.

New Electrical Plant at Eastbourne.

As was briefly mentioned in our issue of May 2nd, the extensions to the plant at the Corporation electricity works, Eastbourne, were inaugurated by the Mayor (Ald. G. B. Soddy), on April 28th. The actual starting-up was performed by the Mayoress.

The principal additions to the station are a 2,500-kW turbo-alternator, a surface condensing plant, and a Stirling 37,500 lb. boiler.

The turbine is by Messrs. W. H. Allen, Sons & Co., Ltd., and is of the high-pressure impulse type, the heat energy in the steam at each stage being converted into kinetic energy by expanding through suitably-designed stationary nozzles. The first stage consists of a velocity wheel element in which the initial pressure and temperature are reduced to within a convenient working range, thereby preventing the distortion of the cylinder end and excessive pressure on the gland. This stage comprises a set of nozzle blocks, two rows of moving, and one row of fixed blades, the expansion of the steam being then continued in single stages until exhaust pressure is reached. The moving and one row of fixed blades, stage are of stainless steel, and the remainder of phosphor bronze, all machined from the solid bar. The stationary blades consist of mild steel vanes cast in the diaphragms. The steam enters through a specially-constructed steam chest, carrying the governor and emergency valves, both of the double-beat type. In the event of the failure of the oil supply, steam is cut off from the nozzle chamber, and a safety governor on the turbine countershaft trips an emergency valve at 10 per cent. over speed. The working pressure at the turbine stop valve is 250 lb. per sq. in., total steam temperature 650 deg. F., and speed 3,000 r.p.m. The condenser is

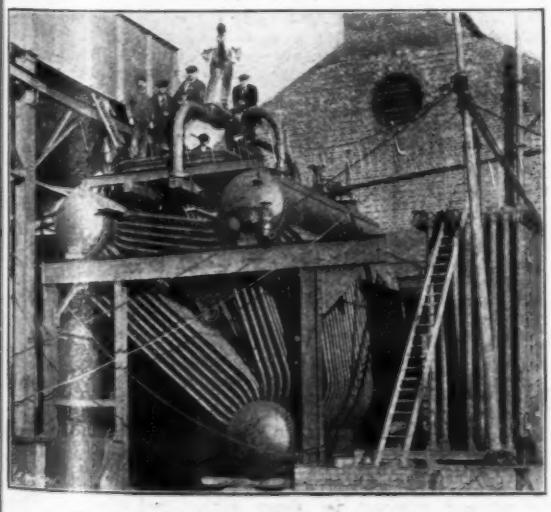

Fig. 2.—Stirling Boiler in course of Erection.

of the Allen contra-flow type, having a cooling surface of 4,500 sq. ft., and containing 1,910 12-ft. tubes. It is designed to maintain a vacuum of 28 in., with the barometer at 30 in. on 25 per cent. overload, with the specified quantity of cooling water—3,150 gal. per min. at 70 deg. F. The air pump consists of primary and secondary steam ejectors working in conjunction with an intermediate condensing receiver. The circulating and condensate pumps are driven by G.E.C. single-phase motors of 70 h.p. and 10 h.p. respectively. The guaranteed steam consumption of the turbine is as follows:—Full load, 12.65 lb. per kWh; three-quarters load (1,875 kW), 12.85 lb.; and 25 per cent. overload, 12.45 lb. On test better results were obtained.

The generator is by the General Electric Co., Ltd. Both the rotor and stator are self-ventilating. The stator consists of a core built up of laminated steel punchings enclosed in an iron yoke. Ventilation is performed by two fans mounted at either end of the rotor. These fans draw air through a duct into one end cover, one fan forcing air through the stator lamina-

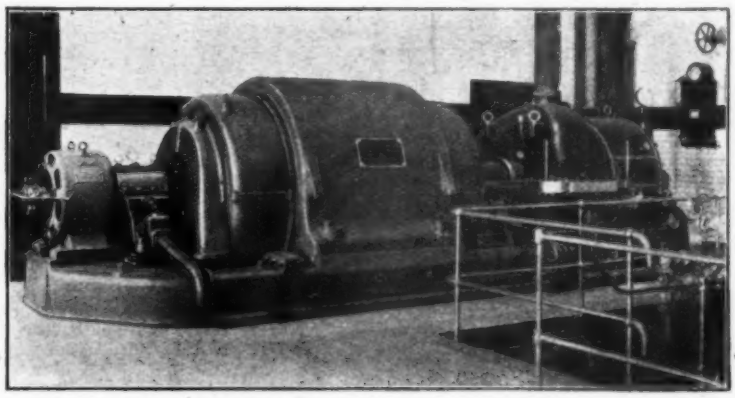

Fig. 1.—New 2,500-kW Allen-G.E.C. Turbo-alternator at Eastbourne.

tions and windings, and the other drawing air through the rotor core and air gap. The air is drawn through a "Visco" filter. The exciter is of the overhung type.

The new boiler house plant consists of a Stirling heavy-duty tri-drum boiler having an evaporative capacity of 37,800 lb. of steam per hour from and at 212 deg. F. at 260 lb. per sq. in. pressure, with a superheat of 250 deg. F. Built integrally with the boiler brickwork is a Green ringstay economiser with a heating surface of 2,730 sq. ft. The gases leaving the economiser pass to a 60-ft. high chimney 6.5 ft. in diameter. In connection with this there is a 55-in. "Sirocco" induced draught fan. The boiler is equipped with travelling-grate stokers by the Underfeed Stoker Co., Ltd.

New coal- and ash-handling plant has also been installed.

A scheme is in hand to run a private siding from the main railway line to save a considerable amount of handling between the railway and power station.

While the new plant works at a pressure of 260 lb. per sq. in., the old plant is run at 175 lb. It has therefore been necessary to insert a reducing valve where the new range is linked to the old, in order that the new boiler may be used with any of the turbines; the system works satisfactorily.

The new generating set is illustrated in fig. 1, while fig. 2 shows the boiler in course of erection.

The Electrical Market in Uruguay.—Don Emilio Boix, the Spanish commercial agent in Uruguay, writing under date of April 30th, in referring to the market for electrical goods in that republic, says that hitherto German imports have predominated, but owing to the inconveniences produced by the French occupation of the Ruhr, business has lately been conducted under great difficulties, enhancing the cost of goods supplied, the price of which is fixed either in dollars or Uruguayan and Argentine gold pesos. Hence resort is being made to the United States, whose prices and exchange methods are more favourable to Uruguay. England is an important caterer for Uruguay with its cables, iron pipes, and other manufactures.

The Inventions of Sir Joseph Wilson Swan, F.R.S.

AN interesting and authentic statement upon the inventions of the late Sir Joseph Wilson Swan (died 1914) in the field of electricity was made by his son, Mr. Kenneth R. Swan, barrister, of London, in a lecture at Sunderland to the local Wireless and Scientific Association, on his father's life and work—the first of an annual series of lectures intended to be given in memory of Sir Joseph in his native town of Sunderland.

Discussing the genesis and development of Sir Joseph's invention of the incandescent electric lamp, Mr. Swan said the fact that in this association the name of Swan was usually linked in the public mind with that of Edison, had often led to the notion that Swan collaborated with Edison in this invention. That was not so. Their work was entirely independent, and though each knew that the other was at work on the problem, they neither met nor had any communication. The conjunction of their names in this familiar linkage arose from the fusion in 1883 of the two competing companies formed to exploit Swan's and Edison's inventions respectively. The successful transformation of the threatened rivalry of these competing concerns into a powerful organisation under the name of the Edison and Swan United Electric Lighting Co. had somewhat confused and clouded the true view of the parts played by Swan and Edison respectively in the evolution of this notable invention. The perspective had been still further obscured and even distorted by the prolonged litigation upon which the company embarked for the purpose of establishing and maintaining its patent monopoly in the face of the widespread infringement which threatened to undermine it.

In face of this confusion (said the lecturer) and in view of the somewhat pretentious and all-embracing claims which had from time to time been advanced on Edison's behalf by his over-zealous compatriots, it was very necessary that an accurate account of the facts should be placed on record. He was fortunate in having in his father's own handwriting a full and detailed statement of these facts, showing from what early beginnings and by what gradual yet persevering and persistent steps he ultimately reached the desired goal. His thoughts were first drawn to the subject of electric lighting by a lecture given in Sunderland about 1851 by W. E. Staite, who exhibited a small electric light produced by means of an electrically-heated wire of platino-iridium. But Staite endeavoured to do an impossible thing. He attempted to demonstrate the practical utility of electric lighting when the nitric acid battery was the best means known of generating electricity. Electric light, in point of fact, had no other practical use at that time than to help in theatrical displays. Joseph Swan was then a lad of 17, and from that time onwards his mind was constantly recurring to this fascinating problem. Significant and suggestive among the early publications which he read on the subject was the specification of King, agent for J. W. Starr, an American inventor, describing an apparatus for producing electric light by means of continuous metallic and carbon conductors in a Torricellian vacuum. This document, published in 1845, was the first suggestion of an incandescent carbon lamp, with carbon in vacuo. Struck with the idea that by means of incandescent carbon in vacuo, a useful form of lamp could be produced, Swan started at once to experiment in order to ascertain how to make an economical lamp on these lines. Even at this early date he realised the desirability of having the carbon conductor as thin as possible, and his first experiments were directed to the attainment of this object by means of carbonised paper and carbonised cardboard. He obtained in 1848 from Mr. Thomas Galloway a great number of specimens of different kinds of paper and cardboard, and after cutting them into strips, and in several instances coiling them in spiral form, he packed them in a mass of powdered charcoal contained in a fireclay crucible, which he then baked to a high temperature in a pottery kiln. In this way he obtained some beautifully thin and flexible strips and spirals of carbonised paper. These experiments extended over some years, and successful results, as regards the production of flexible and strong carbon spirals had been arrived at by 1855 and probably earlier. This carbonisation of thin films or strips of carbonisable material was in itself technically new; carbon in this form and condition of thinness and flexibility was previously unknown.

The next few years were destined to see an immense outburst of inventive activity in that branch of electrical engineering with which the names of Wheatstone, Holmes, Siemens, Wilde, Varley, Gramme, Brush, and many other foster-parents of the modern dynamo would always be associated.

During this period Swan's experimental work was mainly devoted to the development of photography and processes of photographic printing, and although the problem of the incandescent electric lamp still occupied his mind, no further advance was made towards its solution till 1877. The invention of the mercury-vacuum pump, by Herman Sprengel in 1865, had shown the way to get a vacuum far superior to any previously attainable and, following upon this invention, Mr. Crookes (afterwards Sir William Crookes) had in 1875 astonished the world by the exhibition of his radiometer and the description of the improved means that he employed for obtaining the near approach to a perfect vacuum which the construction of the radiometer demanded. It was the publication of Mr. Crookes's researches which led Swan to resume his experiments which aimed at producing an electric light by means of an incandescent carbon conductor in vacuo.

There was in Birkenhead at this time a young bank clerk, Charles H. Stearn by name, who, as Swan discovered through a chance advertisement about radiometers, had been pursuing investigations which required high vacua, and who was familiar with all the manipulative refinements necessary for getting a very high degree of evacuation. Swan, seeing the opportunity of testing the truth of the idea, firmly fixed in his mind, that strips of carbonised paper made incandescent in a very perfect vacuum would be indefinitely durable, wrote to Stearn asking if he would carry out the necessary experiments to establish this point. Stearn agreed to the proposal, and at once commenced a series of experiments with carbon conductors of various forms and sizes, which Swan supplied, beginning with the strips and spirals of carbonised paper and cardboard similar to those used in the abortive experiments of 1860. These were mounted in glass bulbs, which were exhausted to the highest possible degree with the Sprengel pump. Great difficulty was at first experienced in making firm contact between the ends of the carbon strip and the conducting wires between which it was held. To avoid these manipulative difficulties and to arrive more rapidly at a definite settlement of the vital question, namely, whether and under what conditions a carbon conductor could be made durable, the "film" (as the paper strip was then termed, for the name "filament" had not at that time been adopted) was for the time being discarded and other forms of carbon conductor were tried. Amongst the forms used were carbon wires, both straight and bent in an arch, and made of the same plastic material which is commonly used in manufacturing the thicker forms of carbon rod for electric arc lamps. These carbon wires were fitted in small platinum sockets exactly as the thinner carbon filament of later days was mounted. There was another serious difficulty which occasioned a great deal of trouble in the early days of these experiments. It was found that, notwithstanding that the lamp bulb had been very completely evacuated, the vacuum rapidly deteriorated, owing to the evolution of air and other gases from the carbon as soon as the current was turned on and the carbon began to incandesce. In order to meet this difficulty, the plan was resorted to of first producing as nearly perfect a vacuum as could be got by exhausting the lamp bulb while the carbon was cold or only heated by a flame applied to the bulb from the outside, and then, when this point was reached, passing a strong current through it so as to render it brilliantly incandescent, whilst the process of exhaustion was continued at this high temperature. By adopting this expedient it was found possible to obtain a vacuum that was not destroyed when the lamp was put into service. It was also found that the carbon in a lamp thus perfectly exhausted and sealed did not waste away, but was to all intents and purposes indefinitely durable. This important discovery, made before the close of 1878, was in fact the key to the solution of the great problem of electric lighting by incandescence. It was indeed quite fundamental to success, and the practice of continuing the exhaustion during the first incandescence of the lamp has ever since been an essential feature in commercial manufacture. The knowledge gained by this discovery at once brought the manufacture of an incandescent lamp of reasonable durability within the range of practical achievement. Swan continued, in co-operation with Stearn, to push on with these experiments, directing his efforts particularly to the improvement of the carbon. As the straight carbon held between two fixed points showed a tendency to arch when incandescent, a hairpin form was tried, and proved successful. But the most radical improvement was effected by the discovery and use of a new material instead of paper, thread, or other fibrous body as the carbon-forming substance. Swan discovered that by treating cotton-yarn of an open texture (such as lamp cotton) with sulphuric acid, it was converted into a plastic condition, in which it became so agglutinated and compacted as entirely to lose its fibrous condition. It became transparent and, on drying, was hard like catgut, and could be drawn down through dies to a wire of the most perfect roundness. It could, moreover, be bent into spirals and arches, and retained its shape during carbonisation. This material he called parchmentised thread. This improvement was introduced early in 1880, and patented by Swan in November of that year. The carbon filaments (as by this time they had come to be called) made by this process had extraordinary strength and elasticity, they were also perfectly homogeneous, with the result that when mounted in the lamps they underwent little change, even under the action of an extremely high temperature. The filaments so made were, for the purpose of mounting, formed with enlarged ends, held in tiny silver or copper sockets similar to that of a crayon-holder and secured with a slip-ring. But later on improved means were devised for making a good electrical contact between the carbon filament and the conducting wires. This was effected by a joint contrivance of Swan and Gimingham, which consisted in tubulating the ends of the platinum wires and

causing a deposit of carbon to take place at the point of junction of the filament and tube. This method of forming the carbon filament and of uniting it to the conducting wires remained the standard method of manufacturing incandescent electric lamps for many years.

Although Swan had produced and exhibited his first definitely successful lamp as early as December, 1878, he took no steps to patent the lamp, either as a whole or any part of it, until January, 1880, when he obtained a patent for the special process of evacuation, the essential feature of which was continuing the exhaustion of the bulb whilst the carbon was incandescent, for the purpose of removing all occluded gases. He also patented the manufacture of carbon filaments from parchmentised thread, according to the process already mentioned. Swan held the opinion that the broad features of an incandescent lamp containing a carbon conductor in an evacuated glass globe were not patentable in view of the proposals which had been previously made for constructing a lamp having these main features. In his view, only those particular means and processes were patentable at that date which made such a lamp practical.

Edison apparently thought otherwise. Whilst Swan and Stearn were carrying on their joint experiments in Newcastle and Birkenhead, Edison was busily engaged upon the same problem in America. From time to time rumours came across the Atlantic that Edison had attained, or had nearly attained, success. Stearn was keenly apprehensive of the risk of his collaborator being anticipated, and after the success achieved in December, 1878, he repeatedly urged Swan to protect his invention by patent. Influenced by the reason mentioned above, and relying on his already published achievement, Swan made no haste to patent his invention. This was probably a tactical error. Stearn's apprehensions proved well founded. On November 10th, 1879, Edison applied for and obtained a British patent covering, in the broadest terms, the invention of an incandescent electric lamp possessing as its cardinal features a carbon filament within a glass receiver from which the air had been exhausted. So far as the practical manufacture of lamps by Edison was concerned, there appeared to be no record of any exhibition of Edison lamps in this country prior to 1880. The earliest Edison lamps seen in England were apparently six lamps brought over by Mr. Johnson, who was Edison's commercial agent. These lamps were on view in Queen Victoria Street in February, 1880.

Edison lamps were exhibited at the Paris Exhibition in September, 1881, and at the Crystal Palace in the autumn of 1882. The filaments in these early Edison lamps were made from bamboo fibre in accordance with the process described in his patent of 1880, and not in accordance with the process described in his original lamp patent of 1879. It is to be observed, therefore, that for more than a year after Swan had invented and adopted parchmentised thread as the filament material, Edison was still using bamboo. But it was the parchmentised thread and not the bamboo which survived and became the universally-used basis of the filament, and so continued until it was superseded some years later by the squirted filament, also the invention of Sir Joseph Swan. The first public exhibition of a large number of Swan lamps made with parchmentised thread took place on October 20th, 1880, in the lecture room of the Lit. and Phil. Society of Newcastle. This was the first occasion, at any rate in Europe, of the general lighting of a public room by means of incandescent electric lamps. The first private residence other than the inventor's own to be lighted with the Swan lamps was Lord Armstrong's house at Cragside, near Rothbury, in December, 1880. The second installation was in the house of Mr. Spottiswoode, president of the Royal Society. James Coxon, draper, Newcastle, was the first to adopt the Swan lamp for shop lighting, and the fashion spread with amazing rapidity. The applicability for marine lighting was quickly perceived by shipping companies, and the Inman Line was the first to adopt it, their steamer, *City of Richmond*, being the first British vessel to be lighted by incandescent electric lamps, in June, 1881. The light was also installed in many public buildings. By 1882 the Mansion House, the British Museum, the Royal Academy, and the Savoy Theatre and many other large buildings were illuminated with Swan lamps.

The commercial exploitation of the Swan lamp was undertaken initially by a company formed in Newcastle, called the Swan Electric Light Co., Ltd., the manufacture of lamps being at first carried out on a small scale at Birkenhead, and soon afterwards on a much larger scale at Low Fell and Benwell, near Newcastle. This company was, in May, 1882, merged in a larger company formed in London under the name, Swan United Electric Light Co., Ltd. Almost contemporaneously a company had been formed to take over and exploit Edison's English patents for the incandescent lamp. It was not long before legal questions arose between the two companies, which resulted in negotiations, and ultimately in amalgamation, under the title, "The Edison and Swan United Electric Light Co., Ltd."

Dealing with the important litigation upon which the Edison and Swan Co. embarked in 1885 in order to restrain infringement and maintain its patent monopoly, and in which the position of Swan and Edison, in regard to priority of invention, came under judicial consideration, the lecturer said it would be recollected that Swan had publicly exhibited his lamp in December, 1878, and on several occasions in 1879, before the date of Edison's patent of November, 1879. This patent had, in consequence of the amalgamation, become the property of the Edison and Swan Co., and, on account of its exceedingly broad and fundamental claims, gave the company, if the patent could be sustained, a very valuable monopoly. Infringers, or would-be infringers, however, were not slow to perceive that these prior demonstrations by Swan might be used as a means of invalidating Edison's patent. The company was consequently placed in a somewhat awkward predicament. So far as the invention and development of a practical form of incandescent lamp, and the actual processes necessary for its successful manufacture, were concerned, they owed practically everything to Swan and practically nothing to Edison, but so far as the maintenance of their patent monopoly was concerned, Edison was of the greatest value to them. It was of paramount importance to preserve this monopoly. In order to achieve this, it became necessary for the company to satisfy the Court either that the lamps shown by Swan in 1878 and 1879 were failures, or that they were not incandescent lamps containing a carbon filament, for Edison's claims mentioned a carbon filament as an essential feature. Both these lines of argument were urged with all the adroitness and ingenuity for which patent counsel are famous, but the latter argument proved the more effectual, and the crucial question arose: Was the carbon conductor in the Swan lamp of 1879 a filament, or was it not? If it was a filament, then Edison's patent was bad. If not, then the situation was saved. After listening to evidence and argument which lasted many days, the Court of Appeal arrived at the conclusion that the carbon conductor in the Swan lamp was *not* a filament. So the company succeeded in achieving its much-desired object, the maintenance of its monopoly, but not without some incidental diminution of the credit justly due to the inventor, on whose original work their successful manufacture of lamps was in the main actually founded.

Mentioning the later improvements engrafted on the lamp, Mr. Swan said that his father's brother, Alfred Swan, made valuable contributions by his ingenious designs for the now familiar bayonet joint base and holder and by the introduction of "vitrite" as the insulating material of which the base was largely composed. The manufacture of filaments from parchmentised thread held the field till the end of 1883, when Sir Joseph Swan devised a new principle and method of filament manufacture which very soon entirely superseded the parchmentised thread process. According to this method, nitro-cellulose was squirted or discharged under slight pressure through a die or small orifice into a coagulating fluid so as to form a continuous homogeneous thread of indefinite length. This coagulated thread was then cut and shaped to the desired length and form and carbonised in the usual manner. By this improved means filaments could be made of far greater uniformity and fineness than formerly, and consequently it became possible to produce lamps of comparatively low candle power for higher voltages. The advantage and economy thus gained greatly extended the use of incandescent electric lighting, and this process of filament manufacture soon became universal.

Sir Joseph Swan devoted himself to inventing a miner's safety lamp on these new lines, but though in every respect a thoroughly practical and successful design, the cost of the lamp militated against its adoption. Among the kindred electrical problems which also engaged his attention was the question of the electrical storage of energy in connection with electric lighting. In the Faure battery (the usual form of Planté lead secondary cell used at that date) a cloth wrapping was employed to hold the oxide and spongy lead in contact with the surface of the plate. Instead of this somewhat clumsy arrangement, Swan proposed and designed a cellular lead plate into the cells of which the spongy lead could be neatly packed, so as to expose a large surface of active material. This invention was patented in 1881, and the manufacture of cells taken up on this principle by the Electric Power Storage Co. gave practicality to the employment of secondary batteries on a large scale. Swan's cellular plate, slightly varied in a hundred ways, has been the chief feature of all improvements in secondary batteries since Planté made his great discovery, and has proved a valuable contribution to the means of storing electricity and maintaining constant pressure at the generating station.

In the course of his researches, which extended over several years, he made many discoveries of practical value and scientific interest regarding the conditions which control the electrolytic deposition of copper. One instance of an observation of considerable practical utility arising from these investigations may be mentioned, as it affords a good illustration of that type of discovery which springs from some unforeseen and purely fortuitous occurrence in the course of experimentation. Swan was working with a hot solution of nickel, and up to a certain point the deposit had the usual dead grey appearance. Suddenly, and without doing anything more than putting in a new cathode, he found that the character of the deposit had completely changed. Instead of the grey, tough adherent deposit there was produced a brittle, specular deposit, which scaled off in brilliantly shining flakes of metal. This extraordinary change was eventually traced to the accidental introduction into the solution of a minute quantity of glue, dissolved from the bristles of a burnishing brush. Consequent upon this discovery, Swan found that by adding a small quantity of gelatine or similar organic material to a nickel or copper solution he could obtain the peculiar bright and brittle deposit that had resulted from this accident. This means of modifying the character of the deposited metal has since become every-day practice in electro-metallurgical operations.

The London and Home Counties Electricity District.

Commissioners' Third Inquiry.

ON Monday, May 5th, the Electricity Commissioners resumed their inquiry at the Institution of Electrical Engineers into the London electricity supply problem, which was interrupted on the last occasion by the fact that the London electricity supply companies went to the Courts concerning the particular form in which the Order, as it then stood, was drafted; the companies were successful and the Order had to be redrafted in certain particulars, particularly as regards having one Joint Authority instead of a Company Committee and a Local Authority Committee.

Since then, the London County Council has been negotiating with the companies with regard to the postponement of the date of purchase of their undertakings until 1971 on certain terms, which include a sliding scale of prices and dividends. A fair measure of agreement has been reached with what are known as the West End companies, but much less progres has been made with the East End companies, which include the City of London, the South London, the South Metropolitan, and the County of London Companies. Negotiations are still being carried on, however, after having been more or less broken off. On Monday, Mr. Craig Henderson, K.C., for the L.C.C., told the East End companies that if they were willing to enter into an agreement on similar lines to that arranged with the West End companies, the sooner negotiations were resumed the better.

When the inquiry opened on Monday all five Commissioners were present, and it was stated to be their intention to sit day by day. A large number of objections had been sent in from local authority undertakers and company undertakers on matters of detail—a few related to principles and are dealt with later—whilst the railway companies, one gas company, the National Gas Council, the British Waterworks Association, the Electrical Power Engineers' Association and the men's side of the National Joint Council, were represented and will be heard on various points. The Draft Order in its new form will be discussed clause by clause and there will also come up for consideration and discussion the draft agreement proposed by the L.C.C. for the London companies. We will not therefore give the details of this at the moment, as it will come up in due course.

After Sir JOHN SNELL had stated the general line of procedure proposed on Monday morning, a series of general statements were made on behalf of those appearing, indicating the nature of their opposition, and as all these will be dealt with in turn at the appropriate time, there is no need to enter into them now. There is one matter that may be disposed of, however. Clause 12 of the Draft Order deals with the transfer to and lease by the Joint Authority of local authority undertakings, and there seemed to be a very widespread fear that this would be done without the consent of the particular local authority. Sir John Snell intimated that that was not the intention and that no transfer would take place unless the local authority in question was willing so to lease its undertaking so far as the generating station and main transmission lines were concerned.

The principal feature of the day's sitting, and the one which occupied the greatest amount of time, was the contention made by Mr. B. M. MONTGOMERY, K.C., on behalf of the Hornsey, Finchley, and Walthamstow Councils, that it was *ultra vires* for the Commissioners to include in the Order as a compulsory matter the Technical Scheme, and also to provide in the Order for the appointment of a Technical Committee, which is one of the modifications compared with the Order as it was previously drafted. Mr. Montgomery produced arguments in favour of his contention and put it quite bluntly to the Commissioners that unless his difficulty was disposed of in some way—and he intimated that he saw no way out except by the deletion of these two matters altogether from the Order—he would make immediate application to the Courts. He therefore respectfully pressed for an early decision on the part of the Commissioners as to whether they regarded the retention of these two items as vital to the Order, so that, in the event of their decision being unfavourable to him, he could make his application to the Courts at an early stage and not wait until the end of the inquiry, by which time an enormous sum of money would have been spent, perhaps uselessly.

Sir JOHN SNELL at first said that the Commissioners had been advised that the inclusion of the Technical Scheme and the provision for the appointment of a Technical Committee were not *ultra vires*, but Mr. Montgomery was adamant, and suggested that the Commissioners might have been unfortunate in their legal advice, a comment which brought back, no doubt, some reflections to the minds of some of those present, having regard to the fact that the same remark was made by the Chairman on the previous occasion, when the Commissioners' legal advisers were shown to be wrong. However, he promised to let Mr. Montgomery have a decision at an early date, which eventually Mr. Montgomery had to be satisfied with, after safeguarding himself by putting it on record that it must not be said he was the cause of a lot of expenditure which might prove useless.

The point received considerable discussion from all parties, the Chairman turning first to one and then the other for his views. Sir Lynden Macassey, K.C., who appeared for the West Ham Corporation, after stating that there was considerable support among many of those present for the views of Mr. Montgomery, suggested that if the inclusion of the Technical Scheme and the provision for the appointment of a Technical Committee were not vital to the scheme—and he did not think they were—the Commissioners might drop them and go about it in another way—in short, lighten the ship and make its course easier. Sir Lynden pleaded quite earnestly that this should be done.

One of the matters in the minds of those who put forward the view as to *ultra vires*, through Mr. Montgomery, is that the scheme as it stands will give the North Metropolitan Electric Power Co. powers to acquire local authority undertakings in its area which at present are working economically. As a matter of fact, Hornsey and others are going to ask to be taken out of the Power Co.'s area under the scheme, but more will be heard of that later. It is a point which may very well prolong the proceedings not a little.

The upshot of it all was that the Commissioners—after the Chairman had rather, at first, indicated that he would not be hurried—adjourned half an hour earlier than was originally intended, and promised a pronouncement on this matter the first thing the next morning.

Parliamentary.

[By Our Special Parliamentary Reporter.]

Arc Lamp Carbons.—On April 29th, Mr. W. GRAHAM, Financial Secretary to the Treasury, informed Mr. Linfield that the net amount of revenue derived from the duty on arc-lamp carbons during each of the months October to December, 1921, 1922 and 1923, respectively, and during the period October 1st, 1921, to March 31st, 1923, was as follows:—1921: October, £358, November, £706, and December, £658; 1922: October, £55, November, £601, and December, £605; 1923: October, £634, November, £653, and December, £831. From October 1st, 1921, to March 31st, 1923, £7,211.

London Traffic Bill.—This Bill again came before a Standing Committee of the House of Commons last week, and discussion was resumed on Clause 1, which sets up an Advisory Committee of eighteen members to assist the Minister of Transport. Sir D. Newton moved an amendment to provide that two of the members should be nominated by the associations representing gas, water, electricity, and tramway undertakings. He said that he felt that the interests of public utility companies were not adequately safeguarded and therefore these associations should have some representation on the Committee.

MR. GOSLING, the Minister of Transport, resisted the amendment, stating that there would be co-operation between the Advisory Committee and the representatives of these undertakings.

SIR JAMES REMNANT pointed out that, in carrying out certain types of road repairs, it would be necessary to lay cables and pipes and this would take a long time. The streets of London already were practically a network of pipes and cables. They all knew that, so far as electricity was concerned, as the price was reduced so the consumption went up by leaps and bounds. Demands for electricity were very spasmodic in various areas, and very often demands were made practically without notice. It was very important that these demands should be met. Electrical underground schemes had to be thought out well in advance and when roads were being closed for months it was very important that before any schemes for closing these roads was put before the Minister, the representatives of the undertakings themselves should be brought into consultation with the promoters of the schemes.

MR. GOSLING then said he would later accept an amendment to ensure that the undertakings were consulted with regard to road work schemes, and Sir D. Newton thereupon withdrew his amendment. The clause was afterwards agreed to.

On Clause 4, which deals with the closing of streets for works, VISCOUNT CURZON moved an amendment to place "any Government Department" on the same footing as other undertakings which, having statutory powers to break up streets, must, under the Bill, carry out any breaking up of the streets at the same time as works of road maintenance are being carried out.

VISCOUNT CURZON said that one of the authorities which did most damage to London streets by continually pulling them up was undoubtedly the Post Office. It was absolutely essential that the Post Office should be just as amenable to traffic regulations as any private undertaking.

MR. GOSLING opposed the amendment, stating that the Post Office had given a written undertaking which satisfied him, but the amendment was carried.

The Committee then adjourned.

The London Broadcasting Station.—On April 29th, Mr. BAKER asked whether it was proposed to remove the transmitting apparatus of this station from Marconi House to the roof of a leading West-End store.

MR. V. HARTSHORN said that the use of an existing station at Marconi House was agreed to in 1922 as a temporary measure but its continued use was open to serious objections, among which might be mentioned interference with the neighbouring

Air Ministry station in Kingsway. The Broadcasting Co. proposed to construct the permanent London station on the roof of a West End store, which was chosen as being, for technical reasons, the most suitable spot available within the limited area in which the station must be placed. The transmitting station would be private and customers of the stores would not normally be allowed to visit it. He understood that no payment in respect of any supposed advertising advantages was being made to the Broadcasting Co. by the proprietors of the store. At the request of the company, he was consulting the Broadcasting Board on the matter.

Reviews.

Electricity Meter Practice. By H. G. SOLOMON, M.I.E.E., A.C.G.I. Pp. viii+189; figs. 58. London: Charles Griffin and Company, Ltd. Price 7s. 6d. net.

The early chapters of this work deal with the general principles of energy meters. The types discussed are:—

Chapter 1.—Direct current motor meters.
Chapter 2.—Electrolytic, oscillating, and clock meters.
Chapter 3.—Single-phase and polyphase induction meters.
Chapter 4.—Tariff meters.

The last chapter deals with meter testing, and an appendix gives diagrams of connections and brief instructions for testing all the types of meters considered in the main text.

The descriptions are in no way novel, but are quite easily followed. It is unfortunate, however, that the author has not used the standard symbols for electrical quantities.

The descriptions of the mechanical construction of meters are quite clear, but more complete drawings of the standard types could be included with advantage.

The chapter on tariff meters deals briefly with the prepayment and two-rate meters, maximum demand indicators, power factor tariff meters. The information given is sufficient to give quite a fair preliminary knowledge of these instruments.

The chapter on meter testing is very stereotyped, but certainly contains all the information necessary for routine testing of direct and alternating current meters of all types. The author, however, seems to be quite reconciled to the methods which have been in vogue for the past twenty years, and does not appear to have given any serious consideration to the possibilities of entirely revolutionising this class of work. Testing meters by taking disk speeds by means of a stop watch is one of the most tedious jobs imaginable, and in view of the fact that in alternating-current work, at any rate, full-load speeds are now standardised, there seems to be scope for a revival of stroboscopic systems as proposed by Professor Robertson, of Bristol.

The printing of the book is very clear,and the figures—with the exception of No. 37, "Lincoln Demand Meter," which is very crude—are quite satisfactory.

The book is well worth perusal by everyone interested in electricity meters, because of the useful information which it contains. It is, however, almost wholly lacking in inspiration as to improvement of existing methods.

The Choice of Switchgear for Main- and Sub-Stations. By W. A. COATES, M.I.E.E., M.Am.I.E.E. Pp. viii+292; figs. 235. London and Glasgow: Blackie & Son, Ltd. Price 20s. net.

In his preface, Mr. Coates states that the subject of switchgear is dealt with in such a way as to be of maximum assistance to the non-specialist user. He takes a very modest view of the value of his book, as it will obviously be of great value to specialists throughout the world. The book covers the whole field of switching apparatus, from general systems of connections to details of the separate items in a modern switch-house.

Chapter 1, dealing with systems of connections, gives line diagrams showing practically every possible arrangement of bus-bars, and gives brief notes on the advantages and disadvantages of each type. The multiplicity of types shown illustrates clearly the lack of unanimity on the part of electrical engineers as to what should be the standard switchboard arrangement. Mr. Coates does not give any personal opinion as to what he considers best in this respect, and is evidently quite satisfied with the present expensive arrangement whereby each and every power station has its own scheme of connections.

Chapter 2 gives a very clear summary of the use of current limiting reactances. A few years ago it was extremely fashionable to install such devices, and a great deal of money has been spent on them. The reviewer's observations in various large supply systems seem to show that this money was largely wasted. This state of affairs is, however, probably due to lack of judgment on the part of the purchasers, as there is no doubt but that in many cases reactances are extremely useful.

Bitter experience has taught engineers of all large supply systems that oil switches of inadequate capacity are liable to cause tremendous damage in the event of short-circuits. Mr. Coates provides them with a brief, clear chapter which should be extremely helpful in deciding what capacity is required in any particular case. It is hoped that the forthcoming report of the B.E.A.M.A. Research Committee will give a definite ruling as to what the standard makes of circuit breakers can actually clear with safety. The author's own contribution to this subject is given in chapter 5—Oil Switches and Circuit-breakers. This chapter should, in the opinion of the reviewer, have followed immediately after that on the selection of oil circuit-breakers (chapter 3).

The treatment of "Automatic Protective Devices" is fairly complete, but the author does not seem to have large experience of such gear outside the factory. He also unaccountably deals with "Earthing the Neutral Point" under this head.

Chapters 6, 7 and 8 deal with lightning arresters, automatic voltage regulators, and miscellaneous apparatus. The reviewer is at a loss to account for the order in which these subjects are considered, but the information given is very valuable and quite up to the general standard of the work.

The concluding chapters, 9 to 12, deal with direct current, alternating current, high voltage, and automatic sub-station switchboards respectively. The work on high voltage construction is specially interesting, and should be invaluable to engineers engaged on switchgear work for power supply authorities, and to consulting engineers. Carefully chosen examples of American and Continental switchgear practice are included, as well as home productions.

A series of useful appendices deal with the supply to auxiliaries, excitation systems, typical large installations, and cost of switchgear installations. The stations chosen for illustration of switchgear lay-out are: Dalmarnock station, Glasgow Corporation; Barton station, Manchester Corporation; Nechells station, Birmingham Corporation; Back-o'-th'-Bank station, Bolton; Queenston station, Ontario; No. 2 station, Shawinigan; and Mangahao electric power scheme, New Zealand. This part of the book is itself worth the purchase price.

The whole production is up to the high standard of the publishers, printing and reproduction of diagrams being alike excellent.

The reviewer has no hesitation whatever in recommending the book to all electrical engineers.

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(1) Elementary Electricity. By S. G. STARLING, B.Sc., A.R.C.S. Pp. viii+248. Figs. 216. London: Longmans, Green & Co. Price, 3s. 6d. net.

(2) Experimental Electricity and Magnetism. By S. E. BROWN, M.A., B.Sc. Pp. 222. Figs. 193. London: Camb. Univ. Press. Price, 5s. net.

(3) A First Book of Applied Electricity. By S. R. ROGET, M.A., A.M.I.E.E. Pp. viii+143. Figs. 89. London: Macmillan & Co. Price, 2s. 6d.

These three little books all cover the same ground, namely, the elements of experimental magnetism and electricity, and they all do it very well indeed.

From any one of these books a sound working knowledge of the fundamentals of electricity and magnetism may be obtained and that without undue effort or elaborate mathematical equipment. Indeed, it is not too much to say that this amount of electrical knowledge should be possessed by every boy who continues at school till he is 17, whether he be destined for office or workshop, or even for one of those *learned* professions in which *any* knowledge of science is generally regarded as redundant.

The method of treatment in Nos. 1 and 3 is almost identical. Mr. Starling elaborates some sections and illustrates his book more fully than Mr. Roget, but the latter's treatment, though briefer, is adequate and to the point. The chief difference lies in the point at which these two teachers introduce static electricity. In Mr. Starling's book an excellent and compact chapter on this subject is introduced quite early in the book, while two chapters placed near the end of the book are given to this part of the subject by Mr. Roget. Both authors make a point of introducing magnetism early in the book, but do not treat it as a separate subject. Starling's magnetic sections are very detailed, and he also gives chapters to magnetic properties of materials and terrestrial magnetism and thermo-electricity. All three books give brief accounts of X-rays and wireless telegraphy and telephony.

Mr. Brown's treatment is more definitely experimental, and is excellently arranged. The different styles of type serve the very useful purpose of emphasising important sections and the illustrations are well chosen and executed. There is, however, no excuse for the inclusion of the crude hand sketch of a variable condenser on page 163.

Altogether we have little to criticise in any of these little books. The schoolboy who reads electricity and magnetism from them is fortunate in having an exposition of the subject which for clearness and interest is far ahead of any textbook which was available in his father's schooldays.

Cable Ship Rescue.—Lloyd's agent at Mozambique states that the British steamer *Cragness* (5,098 tons) went ashore during the night of April 30th—May 1st at Barracouta Point, 40 miles south of Mozambique. The crew were picked up by the Eastern Telegraph Co.'s cable steamer *Lady Denison Pender* and transferred to the steamer *Karoa*.—*Daily Mail.*

Business Notes.

Bankruptcy Proceedings.—ARTHUR WILLIAM BOULD, 29, High Street, Skipton, Yorkshire, electrician.—The public examination of this debtor was held on April 28th, at the County Court, Manor Row, Bradford. The statement of affairs showed liabilities of £467, and assets of £71, leaving a deficiency of £395. Debtor commenced business in July last, borrowing money, and giving as security a mortgage on a house which he owned. His turnover during the six and a half months he was in business amounted to £905, with business expenses of £386, and his withdrawals for personal expenses £5 a week. Debtor said he had had dealings with money-lenders for about ten years. The examination was adjourned for further inquiries to be made.

T. DAVISON (Radio Technical College), 30, Falkner Street, Liverpool.—Bankrupt's discharge suspended for two years and nine calendar months until January 4th, 1927.

S. B. WESTON (Westforrest Radio Co.), Utworth Manor, Cranleigh, and Playhouse Arcade, High Street, Guildford.—First dividend of 1s. 3d. in the £, payable at the Official Receiver's Office, 29, Russell Square, W.C.

J. MICHAEL, electrical engineer, 6, Sneyd Terrace, and 20, George Street, Newcastle-under-Lyme.—First and final dividend of 5s. 2d. in the £, payable May 7th, at the Official Receiver's office, 12, Lonsdale Street, Stoke-on-Trent.

A. H. DUFFIN & G. KERSHAW (Duffin & Co.), electrical engineers, Provincial Buildings, Colwyn Bay.—Last day for proofs for dividend May 14th. Trustee, Mr. P. W. Aston, Mostyn Chambers, Colwyn Bay.

V. G. BURKITT (V. G. Burkitt & Co.), electrical engineer, 38, Park Road, Bristol.—Last day for proofs for dividend May 16th. Trustee, Mr. F. W. Darley, Official Receiver, 26, Baldwin Street, Bristol.

J. H. WHITEHOUSE, electrical engineer, 61, Martin Street, Morriston, Swansea.—Last day for proofs for dividend May 15th. Trustee, Mr. H. Rees, Official Receiver, Government Buildings, St. Mary Street, Swansea.

HORACE PEPLOW TUCKER, Empire Bungalow, Ellacombe, Torquay, Devonshire, electrician.—The first meeting of the creditors of the above was held on May 2nd at the Official Receiver's Office, Exeter Bank Chambers, 67, High Street, Exeter. The statement of affairs showed liabilities of £401, while the only asset was a life annuity of £52, estimated to realise £500, so that there was a surplus of £99. Debtor attributed his failure to inexperience of business, under-estimating cost of work, and competition.

Dissolutions of Partnership.—IZON & RICKETTS, manufacturers of wireless component parts and accessories, 82a, Bristol Street, Birmingham.—Mr. R. Izon and Mr. A. E. C. Ricketts have dissolved partnership.

J. S. JAYES & Co., wireless and gramophone manufacturers, 45, Bedford Row, W.C.—Messrs. F. H. C. Bishop and Mr. J. S. Jayes have dissolved partnership. Debts will be attended to by Messrs. J. S. Jayes & Co.

Trade Announcements.—MESSRS. FARQUHAR & HEYS, electricians and electrical engineers, are opening new premises in Limbrick, Blackburn.

The London office of BRITISH ELECTRIC VEHICLES, LTD., has been changed from 1, Queen Victoria Street to 36-37, Old Jewry, London, E.C.2. Telephone No.: "6333 Central."

In view of the increasing demand, the Compagnie de Signaux et d'Entreprises Electriques has considerably extended its works at Riom. A branch has also recently been established in Italy.

Mr. R. STIRLING has terminated his agreement with the Foster Engineering Co., Ltd., whose Scottish representative he has been for the past 10½ years, and has commenced business on his own account as R. Stirling & Co., wholesale electrical suppliers, 67, Waterloo Street, Glasgow. He desires to receive trade price lists and circulars.

THE FOSTER ENGINEERING CO., LTD., has transferred its branch office from 67, Waterloo Street to 27, Blythswood Square, Glasgow (Telephone No.: "Douglas 324") under the management of Mr. W. Yuille, late of Messrs. John T. Cartwright.

MESSRS. REAVELL & Co., LTD., have opened an office at 49 & 50, Imperial Buildings, Oxford Street, Manchester, in charge of Mr. S. N. Howe.

Catalogues and Lists.—SIEMENS & ENGLISH ELECTRIC LAMP Co., LTD., 38 and 39, Upper Thames Street, E.C.4.—May price list of electrical appliances, accessories, and materials.

THE MIDLAND ELECTRIC MANUFACTURING CO., LTD., Barford Street, Birmingham.—An illustrated catalogue of "Baby-Paragon" switches, anncuncing reduced prices.

MR. S. H. COLLETT, 52 and 54, Hampstead Road, N.W.1.—A priced and illustrated folder advertising "Excel" fuses, taper pins, and small cable terminals, together with samp'es.

THE BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, W.C.2.—An illustrated booklet dea'ing with the "Radiola III" radio-telephone receiving set. Priced.

SWEDISH GENERAL ELECTRIC, LTD., 5, Chancery Lane, W.C.2.—Circular E.IV.9, describing, with illustrations, a new time limit overload relay.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Strand, W.C.2.—Sheets Nos. 28-32, describing the 3-kW type "U" transmitter. Pamphlet No. 228, illustrating and describing general utility receivers, including direction finders. Pamphlet No. 225/2, dealing with multi-valve amplifying detectors, l.f. magnifiers, and accessories. Pamphlet No. 227/2, describing the Marconi aerodrome ground station.

THE TELEPHONE MANUFACTURING CO., LTD., Hollingsworth Works, Martel Road, West Dulwich, S.E.21.—A well illustrated booklet dealing with the marine "Laryngophone" and its applications.

MESSRS. WARD & GOLDSTONE, LTD., Frederick Road, Pendleton, Manchester.—A priced and illustrated leaflet advertising violet-ray high-frequency apparatus.

THE BRITISH ELECTRIC TRANSFORMER CO., LTD., 50, Oxford Street, W.1.—Catalogues 37 and 37A dealing respectively with "Flamingo" fires, tableware, &c., and cooking apparatus, including ovens, boiling plates, immersion heaters, &c., together with lists of reduced prices. Also a priced and illustrated pamphlet describing the "Tricity" combination cooker.

MESSRS. SIEMENS BROS. & CO., LTD., Caxton House, Westminster, S.W.1.—Catalogue 170, containing particulars of insulating tapes and compounds; and Catalogue 175, dealing with chain-type cable hooks.

MR. J. A. HIGGINS, 28, Park Street, Clayton, Manchester.—An illustrated and priced pamphlet dealing with c.i. lighting fittings.

MESSRS. RANSOMES, SIMS & JEFFERIES, LTD., Ipswich.—A well-illustrated catalogue containing details of electric industrial trucks of various types.

WESTINGHOUSE ELECTRIC INTERNATIONAL CO., 2, Norfolk Street, Strand, W.C.2.—Illustrated pamphlets describing "autovalve" lightning arresters, electrically-driven centrifugal pumps adapted to pipe line use, and electrical equipment for buildings.

ELECTRIC EQUIPMENT MANUFACTURERS PTY., LTD., Normanby Road, South Melbourne, Vic.—Leaflets Nos. 41 and 42, describing, respectively, instrument changeover switches and current transformers.

LE CARBONE, Coventry House, South Place, E.C.2.—A brochure describing the construction and performance of the "AD" cell.

THE LANCASHIRE DYNAMO & MOTOR CO., LTD., Trafford Park, Manchester.—New descriptive list of "Lancashire" squirrel-cage motors, type MT (List 701).

Book Notices.—"Memorandum by the Senior Electrical Inspector of Factories on the Electricity Regulations" (Third Edition). London: H.M. Stationery Office. Price 1s. net.—The preface states that this is a reprint of the previous edition, with the substitution, in Appendix II, of the Electricity Commissioners' Regulations, for the previous Board of Trade Regulations for Overhead Lines.

"The *Journal* of the Junior Institution of Engineers." May, 1924. London: Percival Marshall & Co. Price 2s.—This issue contains a list of officers for session 1923-24; a biographical note of Sir J. Fortescue Flannery, Bart. (President); a paper on "Water-Tube Boilers," by L. M. Jockel; abstracts of lecturettes; reports of visits, &c.

Unemployment.—There was an increase of 11,313 in the number of registered unemployed during the week ended April 21st. There has, however, been a reduction of 235,000 since the commencement of the year.

Recent Contract.—MESSRS. BASTIAN & ALLEN have recently shipped ten "Bastian" electric storage geysers for installation in the new Government buildings, Delhi. Several of these geysers have also been installed at the British Empire Exhibition.

British Trade-mark Applications.—The following are included among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from the dates mentioned:—

Dominoe. No. 445,830. Class 8.—Plug switching apparatus for telephones and for similar electrical purposes. The Magneta Time Co., Ltd., 14 & 16, Carteret Street, Westminster, S.W.1. April 39th, 1924.

Wootophone. No. 446,637. Class 8.—Apparatus for wireless telegraphy and telephony. F. E. Wootten, Ltd., 55, High Street, Oxford. April 30th, 1924.

Dexa. No. 439,831. Class 13.—Electric lamps. Hugh Fleming, trading as H. Fleming & Co., The Pillars, High Street, Dundee. April 30th, 1924.

Duraxa (lettering and design). No. 446,681. Class 8.—Instruments and apparatus for use in wireless telephony and telegraphy. Frank H. Page, 123, Oakfield Road, Penge, London, S.E.20. April 30th, 1924.

Sterling Dinkie (lettering and design). No. 446,946. All goods in Class 8.—Sterling Telephone & Electric Co., Ltd., London, W.1. April 30th, 1924.

Insulol. No. 444,599. Class 50. Oils prepared for electrical insulating purposes. Sterns, Ltd., 16, Finsbury Square, London, E.C.2. April 30th, 1924.

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 6th:—Copper (electrolytic) bars, £69 10s., 5s. decrease; do. do. sheets, no change; do. do. wire rods, £79 10s., 5s. decrease; do. do. h.c. wire, no change.

Messrs. James & Shakespeare report May 6th:—Copper bars (best selected), sheet and rod, no change; English pig lead, £31 5s., 35s. decrease.

South African Electrical Imports.—The following statement shows the value of the imports of electrical goods into the Union of South Africa in 1923, according to the official returns. The figures for 1922 have been added and notes of the increases or decreases are given:—

	1922. £	1923. £	Inc. or dec £
Electrical material and machinery.—			
Batteries, primary	11,000	24,000	+ 13,000
" secondary	22,000	50,000	+ 28,000
Cable and wire	198,000	360,000	+162,000
Heating and cooking apparatus	25,000	30,000	+ 5,000
Lamps, incandescent	90,000	112,000	+ 22,000
Motors and parts	87,000	225,000	+138,000
Transformers	19,000	48,000	+ 29,000
Other electrical material ...	528,000	605,000	+ 77,000

German Trade Activity in South America.—The *Monthly Review* of the Bank of London and South America, Ltd., for April states that German trade with Argentina grows in volume and value month by month. "There were 22 steamers loaded in German ports with general cargo which arrived in Buenos Aires between February 1st and 27th, including one whole cargo of Baltic pine. Cellulose, printing paper, fencing wire, and steel and iron made up the majority of the bulkier goods, while every description of manufactured article was to be seen on the manifests. In rough goods and hardware the most noticeable feature of the month was the large quantity of steel and iron coming hither to well-known German houses, no less than three large consignments, which came near to being whole cargoes, arriving for the Cia. Thyssen Ltda. A large amount of Decauville material also came from German shippers to various consignees." In another place the report refers to the small number of motor-cars possessed in Brazil in proportion to her population and territory, suggesting that there is room for British activity in this department of trade.

For Sale.—Heston and Isleworth U.D.C. electricity department has for disposal two 125-kW d.c. control panels complete. The Roads and Communications Officer, Salisbury, invites offers for a quantity of l.p. cable lying at Lakedown Aerodrome. (See our advertisement pages to-day.)

The International Glow Lamp Syndicate.—As is perhaps fairly well known, with the exception of some of the smaller factories turning out glow lamps, all the important undertakings in Europe are combined in the form of an international syndicate, which exercises a controlling influence on prices in different countries. A little time ago it was found necessary for the parties to the agreement to meet in Berlin, when it was decided not only to adhere to the fixing of prices, but also to extend the scope of the syndicate to foreign markets in the sense that each works was allotted a specific number of lamps as the maximum measure of its export possibility to a definite country. In other words, a lamp export contingent has been fixed for each works, the explanation being found in the circumstance that the productive capacity of all the factories is largely in excess of the demands of the markets. In connection with this new orientation of the business it is announced that the Austrian Lamp Sales Association, which consisted of three undertakings under the name of the "Metax," has been dissolved owing to the disintegration of the dual monarchy and the consequential loss of markets, while at the same time new lamp factories have been created in the Succession States.

Engineering Conference.—The invitation of the engineering employers to the 17 trade unions, with which the workers in the engineering industry are organised, to set up a committee to consider measures for the avoidance of disputes, has led to the arrangement of a conference for May 14th.—*The Times.*

Local Exhibition.—STOKE-ON-TRENT.—The borough electrical engineer (Mr. C. H. Yeaman) has sent us a copy of the catalogue produced in connection with a "Heat, Light, and Power Exhibition" held at Hanley from April 24th to May 3rd. The exhibition was arranged by the Corporation's Electricity and Gas Departments, and there were nearly 80 exhibitors of heating, cooking, and lighting equipment, and appliances for other branches of gas and electricity utilisation. Most of the larger electrical firms were represented. Valuable features of the catalogue are the advice on lighting and a short history of electrical development by Mr. Yeaman.

New French Companies.—A new company has lately been formed in Paris (11, Rue du Pont, Suresnes), with a capital of 500,000 fr. and the title La Société Hewittic, to enter into an agreement with the Hewittic Electric Co., Ltd., London, for the manufacture of the Hewitt mercury lamp, &c., in France.

A new company has lately been formed in Paris (5, Rue Jules Lefebvre) with a capital of 20 million fr., and the title La Société Hydro-electrique de la Diege, to establish hydro-electric plants in the Department of Correze.

Exports to Germany.—Discussing the growth of the electrical manufacturing industry in England in 1923 and the development of the export trade, a writer in a German newspaper points out that the English electrical exports to Germany are so insignificant that they are not even specifically enumerated in the German official statistics.

Wembley Engineering Display and its Lessons.—"Wembley can teach the world certain lessons; equally, I believe, we can learn from it. For example, a critical inspection of the Palace of Engineering reveals the fact that British engineering and metallurgical practice is able to deal effectively with the equipment of any and all of the world's industries in every technical direction. It discloses that, as regards inventive ingenuity, sane design, sound material, and unquestionable workmanship, we are second to none. Now let me carry the examination a little further. If we consider to-day's British prices for engineering products and compare them with our pre-war prices, and then consider the multitude of new and additional elements which have now to be covered in our costs, two conclusions are definitely forced on us; first, that our technical efficiency of production must have sensibly increased, and, next, that there can be little possible margin of profit. The engineering display, taken as a whole, complete refutes any charge of decadence or slackness in the technical progressiveness of our industry. At the same time, gentlemen, we cannot deny that the courage and enterprise displayed in our engineering exhibits is really a national gesture, and is in no sense a reflection of any degree of true prosperity. Behind the Wembley picture we are forced to realise the existence of the low-wage rates of our skilled men, the high ratio of unemployment in many sections of the industry, the keenness of competition, the difficulty of obtaining contracts, and the unstable faith and confidence of the consumer. To these facts I would add that we are now faced with demands for wage increases, with higher prices of coal and consequent increase in the prices of all our raw materials, while at the same time we cannot be blind to the nature of some of our recent contracts—in some degree they are highly artificial in their genesis."—*Extract from the speech of Lord Weir at the British Engineers' Association Luncheon last week.*

Russian Electric Steel Works.—The General Metal Commission has sanctioned the provision of a new rolling train for the Electro-Steel Works on condition that the train is made by a Russian works. The order has now been placed with the Kramatorsky works, which has undertaken to deliver it at a price not higher than that of a foreign train, plus import duty and cost of freight.

Czecho-Slovakia.—A net profit of 10,798,960 kr. was made in the past year by the Ceskomoravska-Kolben Aktien-Gesellschaft, Prague, from which a dividend of 320 kr., or 40 per cent., was distributed. The only department which was fully employed during the year was the electrotechnical. The company has just secured the contract of building a power station to supply the city of Spalato with electricity, for the carrying out of which a company has been formed with a capital of 20,000,000 dinar, of which the city subscribes 62 per cent., the remainder of the capital being provided by the former Spalato water power company and the Ceskomoravska.

Taxation and Industry.—As the British Chambers of Commerce will probably be invited to give evidence before the Parliamentary Committee on National Debt and Taxation, steps are being taken to ascertain the views of the various Chambers on a series of questions submitted which cover the whole field. It will be remembered that the Committee, under the chairmanship of Lord Colwyn, is charged "to consider the report on the National Debt, and on the incidence of existing taxation, with special reference to their effect on trade, industry, employment, and national credit." With such wide powers it is necessary that the Committee should regard the problem from every angle, and in consequence the inquisition in which the various Chambers of Commerce are invited to participate is of a very searching character. There are sixteen questions, starting with the effect which the National Debt has on the supply of credit and of permanent capital for trade and industry, with particular reference to the effect of the Floating Debt; and ending with the effect of the Customs and Excise duties on the prices of commodities, and on internal and external trade. Individual members are being invited to submit to their Chambers their views of all or any of the questions, *in writing*, these views to be collated and summarised by the various Parliamentary Committees for submission to the Central Chamber.

Some of the questions will no doubt be exhaustively treated by those commercial leaders who have special knowledge of the subject, as it would be next to impossible to answer them in a few words; and some of them touch points that have agitated industry for a long time past. For instance, particular attention is being paid to the effect of a high income tax on the withdrawal of trade income that could otherwise be counted on for the expansion of business, "and which, so capitalised, would produce a high rate of profits due to managing ability and to the calculated risks of personal enterprise." Another point is the advisability to pursue a policy of debt repayment during a period of trade depression. The incidence of Death Duties and Stamp Duties is also to be investigated; while Question 15 is likely to arouse an old controversy: "To what extent (*a*) in the present depression, and (*b*) in a period of normal trade, is the ordinary assumption correct that the tax on commodities is borne by the consumer?"

Never before has such an exhaustive inquiry been submitted to the individual members of Chambers of Commerce, and the results of the inquisition should be valuable.

Metric Equivalent Tables.—THE CENTRAL TRANSLATIONS INSTITUTE, LTD., 807-8, Salisbury House, E.C.2, has sent us a copy of a set of tables for the conversion of English measures to their metric equivalents and *vice versa*. It is issued at 6d. (post free).

Social Event.—On Saturday, April 26th, the management of the Union Cable Co., Ltd., in accordance with a long-standing custom, entertained the whole of its staff from Dagenham Dock at a concert at St. Margaret's Hall, Barking. Mr. J. Snow Huddleston, general manager, presided, and at the close Mr. H. C. Goodwin voiced the thanks of the employés.

District Council's Report.—In the annual report of the District Industrial Council No. 5 for the Electricity Supply Industry (West Midlands Area) it was stated that the proceedings during the year had been conducted in complete harmony. No difficulties had arisen which it had not been found possible to deal with satisfactorily by negotiation. An application for a general advance of 10s. per week in the rates of pay of all employés has been referred to the various district councils for negotiation. The hope is entertained that a satisfactory settlement may be reached shortly.

Success at the Calcutta Exhibition.—The Cable Accessories Co., Ltd., informs us that it was awarded a gold medal for its exhibit of electric light fittings, fires, switches, fuses, radio apparatus, &c., at the recent Calcutta Exhibition.

British Empire Exhibition Notes.—MESSRS. A. REYROLLE AND CO., LTD., have issued a little pocket book which acts as a guide to their stand, and provides a convenient detachable-leaf memoranda pad.

BROOKHIRST SWITCHGEAR, LTD., has sent us a list of some of the switchgear which it has supplied to numerous exhibitors in connection with their displays. The company's control panels are very largely represented.

Swiss Industries Fair.—We are informed that the electrical industry will be substantially represented at the eighth Swiss Industries Fair to be held at Basle from May 17th to 27th. The Fair will be housed, on the coming occasion, in new quarters, the former Fair buildings having been destroyed by fire. Dr. Meile is the managing director. Last year traders from 21 different countries attended the Fair.

Tramway Employés' Wages.—Acting against the advice of their union, which recommended that the application for increased wages should be treated as a national matter, the employés of the Manchester tramway undertaking have applied for an increase of 8s. per week.

Lighting and Power Notes.

Argentina.—HYDRO-ELECTRIC SCHEME.—According to the report of the Sociedad de Empreza de Luz y Fuerza, of Mendoza, the Supreme Court of the Argentine has given a verdict in its favour in respect of the action brought against the Government relative to its concession for the establishment of a hydro-electric generating station on the River Mendoza. As a result of this verdict, negotiations have been entered into with the Government for a new concession for a period of 65 years, which will enable the company to considerably extend its tramway and electricity undertaking. New plant, consisting of a 1,000-h.p. Diesel engine and dynamo, was added to the central station during March last.

Barnstaple.—LOANS.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £2,250 for a 300-kW generating set, and to a loan of £852 to cover excess expenditure on condensing plant. Application has been made for a further loan of £2,400 for a coal conveying plant, &c., for the electricity works, and for a loan of £1,000 for extending the cables to Sticklepath Hill.

Barrow.—PROPOSED WATER-POWER SCHEMES.—The General Purposes Committee has authorised the Electricity Committee to make further investigations into the proposed utilisation of the water-power at Backbarrow, on the River Leven, upon which the electrical engineer has submitted a report and scheme, and to report again on the proposal. Messrs. Vickers, Ltd., have offered to assist the Corporation in this matter.

Burnley.—ELECTRICITY SUPPLY.—At a recent meeting of the Electricity Committee it was decided to carry out various extensions to mains and construct a sub-feeder in Padiham Road district. The electricity engineer was instructed to report on the possibility of extending the electricity supply in Higher Brunshaw district by overhead wires. The Committee decided to install a 1,000-kW rotary converter at the electricity works.

Chester.—EXTENSION OF SUPPLY.—The Electricity Committee, after negotiation with the Duke of Westminster, has decided to give a supply of electricity to Eaton Hall and to Eccleston. The terms include a guarantee of a gross annual income of £1,000 from this area.

Connah's Quay.—ELECTRICITY IN BULK.—The Council has entered into an agreement with the North Wales Power Co. for a bulk supply of electricity, and expects to be in a position to distribute electricity by the commencement of next winter. Sanction has been obtained from the Electricity Commissioners to loans for the following work:—The erection of overhead wires and underground mains; services; excavations, &c.; and the erection of a sub-station.

Continental.—BELGIUM.—In the report for last year, the Société des Centrales Électriques des Flandres, of Brussels, states that the capacity of the main generating station has been increased to 24,000 kW, and that of the 104 sub-stations from 19,250 to 24,700 kW. The length of the h.p. distribution mains has been extended from 171 to 184 miles, and the l.p. mains from 195 to 210 miles. In order to meet the increasing demand for electricity, the capacity of the central station is to be increased to 30,000 kW.

A new steam turbo-generator of 2,000-kW capacity is to be installed at the power station of the Société des Ciments de Thieu, of Thieu.

FRANCE.—A concession has been secured by the Société Hydroélectrique de la Tardoire, of Montbron (Charente), for the construction of an electrical distribution network for public and private requirements in the departments of Charente and Dordogne.

The Société Électrique du Nord-Ouest has been authorised to erect a h.p. transmission line to supply the city of Bethune, and a second line to link up Bully, Lozinghem, and Beuvry and the St. Omer district, and also a h.p. line from Andruick to Tournehem, linking up five communes. Sanction has also been given to construct a l.p. transmission line to supply 15 communes in the department of the Pas-de-Calais.

The Société Hydroélectrique de la Diège has been formed to take over certain concessions and undertakings from the Société des Hauts Fourneaux et Fonderies de Pont-à-Mousson, situated in the department du Corrèze. The scheme includes the transfer of works and undertakings for harnessing the River Diège, in the commune of Roche-le-Peyroux. The company's capital is 20,000,000 fr.

The plant at the generating station at Gennevilliers of the Union d'Électricité, of Paris, is shortly to be increased by the addition of a sixth generating set of 40,000 kW.

SWEDEN.—At the annual meeting of Svenska Vattenkraftföreningen, it was stated that the water power developed in Sweden totalled 1,530,000 h.p. at the beginning of 1924. A power station is under construction at Lilla Edet, which will have a capacity of about 30,000 h.p., and at Lanforsen, on the Dal River, with a capacity of about 33,600 h.p. The Lilla Edet works will probably be completed next year, and those at Lanforsen in 1927.—*Reuter's Trade Service* (Stockholm).

RUSSIA.—The Soviet Government has, it is reported, nationalised the plant of the Société de Force Électrique de Baku. The plant at the generating station is to be increased by the addition of two 10,000-kW turbo-alternators and three boilers.

Coventry.—LOANS.—The Electricity Committee has recommended to the Town Council that application be made to the Electricity Commissioners for sanction to the borrowing of £30,000 for mains and £10,000 for transformers and sub-station equipment.

Edinburgh.—PROPOSED NEW PLANT.—At a recent meeting of the Corporation, the recommendation of the Electricity Committee to install a 15,000-kW generating set at Portobello station was discussed. It was pointed out that additional plant must be installed for the winter of 1925-26. There is an alternative proposal that the existing buildings at Portobello be extended to accommodate two generating sets of 25,000 kW each, and that one set of 25,000 kW be purchased in the meantime, the estimated cost being £372,000. In view of the importance of the subject, the discussion was adjourned to a special meeting to be called at an early date.

Ayrshire Electricity Board.—The Ayrshire Electricity Board, which has taken over the Kilmarnock and Ayr electricity undertakings, and now operates the electric supply in the county of Ayr and burghs therein, held its first meeting at Kilmarnock, on Friday last, May 2nd. Mr. Bexon, who is the engineer and manager of the Kilmarnock Corporation Electricity Department, has been appointed by the Board as engineer and general manager. All negotiations relative to the public supply in Ayrshire, in future, should be addressed to Mr. W. C. Bexon, Power Station, Greenholm Street, Kilmarnock.

Haslingden.—LOAN SANCTIONED.—The Council has received the sanction of the Electricity Commissioners to the borrowing of £5,000 for mains.

High Wycombe.—ELECTRICITY SUPPLY.—The Rural District Council has decided to consent to Aylesbury Corporation extending its cables into the rural area and supplying consumers direct.

Irish Free State.—KINGSTOWN (CO. DUBLIN).—At a recent public meeting it was unanimously resolved to oppose the Dublin Electricity Supply Bill, the East Leinster Electricity Supply Bill, and the Irish Hydro and Peat Electric Power Bill at present before the Dail.

DUBLIN.—The Corporation is installing a 5,000-kW steam turbo-alternator, with condensing plant and pipework, at the Pigeon House electricity works, the cost to be met out of revenue.

Kingussie.—PROPOSED WATER-POWER SCHEME.—The Town Council has under consideration a proposal to introduce an electricity scheme in the town. A water-power scheme is favoured, and the Council is negotiating with the proprietor of Loch Guynack with a view to utilising the lake for this purpose.

Liskeard (Cornwall).—PROPOSED ELECTRICITY SUPPLY.—The Town Council has deferred for further information applications from a Plymouth firm and the Liskeard Gas Co. for approval and assistance to schemes for providing an electricity supply in the borough. It was stated at a recent meeting of the Council that negotiations had been proceeding with the Plymouth firm since 1920, and the Council had practically given it permission to proceed, but was anxious not to allow the establishment of a monopoly.

London.—FULHAM.—Owing to a breakdown at one of the sub-stations on April 30th, the electricity supply in the vicinity of Walham Green was cut off for about 20 minutes.

Lytham St. Annes.—YEAR'S WORKING.—For the year ended March 31st last, 2,868,282 kWh was sold, as against 2,277,875 for the preceding year, and the number of consumers connected was 4,914.

Manchester.—YEAR'S WORKING.—The accounts of the electricity undertaking for the past year show a profit of £110,224. The sale of electricity has increased by 36 million kWh as compared with the previous year, the respective figures for the two years being 222 and 186 million kWh. The number of consumers has increased from 27,510 to 30,554.

Price Reduction.—ISLINGTON.—The increase on pre-war charges is to be reduced from 50 to 25 per cent. for all electricity other than public lighting.

Rawtenstall.—YEAR'S WORKING.—There was a profit of £6,400 on the electricity undertaking during the past year.

St. Asaph (Flint).—ELECTRICITY SUPPLY.—The Rural District Council has consented to the application of the Gwynedd Trust for an Order authorising it to supply electricity in the district. The Council has decided not to support the application of the Prestatyn Urban District Council for power to supply electricity in the parishes of Meliden and Dyserth.

Tamworth.—ELECTRICITY SUPPLY.—The Town Council proposes to enter into an agreement with the Poole Hall Colliery Co., Ltd., Polesworth, for a supply of electricity to the borough. The company will undertake all the work in connection with the scheme, and provide a supply for three years, when the undertaking is to be handed over to the Council. The estimated cost of the scheme is £25,000, which includes the laying of mains and 1,000 services. The scheme is to be submittted to the Electricity Commissioners for their approval.

Ulverston.—INQUIRY.—On April 29th, Col. T. C. Ekin held an inquiry into the application of the Urban District Council for a Special Order authorising it to supply electricity throughout the urban district and the parish of Osmotherley, in the rural district of Ulverston, by obtaining a bulk supply from Barrow. Mr. F. W. Poole, clerk to the Council, who outlined the proposed scheme, stated that it provided for overhead transmission lines from Barrow and the supplying of electricity by the Barrow Corporation at a charge of 1.25d. per kWh. It had been agreed that Ulverston should receive 2½ per cent. commission on electrical energy taken by other bodies on the line of route between Barrow and Ulverston. Objections were made to the scheme on the ground that there was a possibility of the scheme becoming a charge upon the local rates. The inquiry was closed, and the inspector visited the proposed site of the sub-station.

United States.—ELECTRICITY SCHEMES.—According to the *Electrical World*, work has commenced on the Illinois Electric Power Co.'s steam plant on the Illinois River, opposite Peoria. The station will eventually have five sets, with a total capacity of 100,000 kW. The section now under construction will include two 20,000-kW turbo-alternators, each served by two boilers fired with powdered coal. Electricity will be generated at 13,200 V, and the supply for local consumption will be transmitted across the river at this voltage by submarine cables to the Peoria station. The supply to Springfield, Ill., a distance of 70 miles, will be stepped up to 132,000 V.

THE MUSCLE SHOAL PLANT.—The War Department has recently placed an order for four vertical waterwheel G.E. generators for the Wilson dam hydro-electric project at Muscle Shoal. The four generators are each rated at 32,500 kVA, 26,000 kW, 0.8 p.f., 100 r.p.m., 12,000 V, three-phase, 60 cycles. These generators will compose a part of the proposed installation of 18 sets, which will have a total ultimate capacity of approximately 450,000 kW.—*Power.*

Whitchurch.—SPECIAL ORDER.—The Whitchurch and District (Hants.) Gas Co., Ltd., has applied to the Electricity Commissioners for a Special Order, authorising it to supply electricity within certain parishes in the rural district

York.—NEW PLANT.—In order to meet a demand from the London & North-Eastern Railway Co. for an electricity supply, the Electricity Committee proposes to install one 6,000-kW turbo-generator, with a new switchboard and a 30-ton crane, at the electricity works, and to remove a 1,250-kW set, at an estimated cost of £36,800. Application is to be made to the Electricity Commissioners for sanction to the borrowing of £10,000 for mains.

Tramway and Railway Notes.

Australia.—HOBART (TASMANIA).—The Tramways Committee has submitted a proposal to the Government Railway Department to run tramcars on the railway lines.

MELBOURNE.—The chairman of the Tramways Board announces that the Board is proceeding immediately with the conversion of the cable tramways to electric traction at a cost of £4,000,000.—*Reuter* (Melbourne).

Birmingham.—NEW ROUTE.—The extension of the tramway system to the Lickey Hills was recently completed. The electrical energy for the new route is supplied by the Corporation Electric Supply Department.

Blackpool.—YEAR'S WORKING.—During the year ended March 31st last, 35½ million passengers were carried on Corporation tramway and 'bus services, an increase of nearly 3½ millions over the preceding year. The passengers carried by the tramway undertaking numbered 34,467,843, an increase of 2,927,055, and the receipts were £273,041, an increase of £3,379, the receipts per car mile being 25.15d., as against 26.25d.

Continental.—SWITZERLAND.—It is announced that the electrification of the Olten-Basle section of the Federal railway system has now been completed, and that electrically-operated trains are now being run from Basle to Chiasso, *via* the St. Gothard tunnel, a distance of 210 miles.

The plan for the electrification of the Swiss railways, drawn up in 1914, has undergone notable changes. At first 1930 was appointed as the date for the termination of the work; now it is hoped that the conversion to electric traction will be completed next year. Electric trains are already running on the Saint Gothard, Chiasso-Lucerne-Zurich, Lucerne-Olten, Goldau-Zug, Immensee-Rothkreuz, and Berne-Thun lines. On the Simplon line the Isella-Sion section has been electrified. The Zurich-Berne line (150 kilometres) will be finished in 1925. —*Reuter's Trade Service* (Berne).

PORTUGAL.—Contracts have recently been placed for the electrification of the railway between Lisbon and Cascaes, which serves the seaside resort of Mont Estoril.

Dearne Valley.—LIGHT RAILWAY.—It is anticipated that the Dearne Valley Light Railway will be completed by the end of June, when it is proposed to connect it with the undertaking of the Mexborough and Swinton Tramways Co., and run through services on two systems.

Soudan.—KHARTOUM.—The Municipal Council has under consideration a project for the linking-up of Omdurman and Khartoum with a tramway. A company will take up the matter if negotiations prove successful.—*Electric Railway and Tramway Journal.*

Houghton-le-Spring.—TRAMWAY SERVICE WITHDRAWN.—The Sunderland District Electric Tramways, Ltd., has notified the Rural District Council of its intention to discontinue the tram service from Herrington Burn to Penshaw. A motor-'bus service is to be substituted.

London.—RAILWAY ACCIDENT INQUIRY.—The Ministry of Transport opened an inquiry on April 30th into the collision which occurred on April 27th near Euston between an excursion train from Coventry and an electric train from Watford. Percy Gower, driver of the excursion train, stated that he was pulled up by the home signal just outside Euston. After the train had halted for a few minutes he sent the fireman up to the signal box to remind the signalman that the train was still standing. The guard of the electric train said he was not aware that anything was wrong until the brake of the train was suddenly applied. Arthur Haggis, signalman at Camden No. 1 box, stated that the excursion passed his box at 7.49 a.m. Just afterwards the 7.15 electric train from Watford was offered to him and accepted. Arthur Chambers, an assistant in Euston No. 4 box, said that one of the two trains was accepted on the fast line. The signalman at Camden No. 1 box then offered him the electric train on the slow line, and he accepted, thinking that the excursion train was on the fast line, whereas it was on the slow line. The inquiry was adjourned.

Rawtenstall.—YEAR'S WORKING.—The accounts of the Corporation tramway undertaking for the year ended March 31st last show a profit of £657.

United States.—NEW YORK.—According to *The Times*, details of a scheme calling for the expenditure of $687,000,000 in connection with the suburban transport problem of New York have been announced by the Transport Commission. The plan, drawn up by the Commission's consulting engineer, Mr. D. L. Turner, involves the construction of a railway system designed exclusively for suburban traffic within a radius of 40 miles round Manhattan Island. It is proposed to construct a four-line loop underground railway in Manhattan, making a belt through 57th Street, running thence "down town" on the West Side to the Battery, "up town" on the East Side, and continuing to a terminus in the Bronx at 149th Street. An outer double-line, and in some places four-line, loop would link up the termini at Jamaica,

Long Island, and at Jersey City, and new termini for five railways and two other places in New Jersey about five miles from Manhattan. In New York City it is proposed to construct two "super streets," 120 ft. wide and in three levels—the top for light traffic, the middle for heavy vehicles, and the lowest for subways. The cost of the scheme would be borne, to the extent of $18,000,000, by the railways of New York and New Jersey, $93,000,000 by the City, and the remainder by the State and county governments of New York, New Jersey, and Connecticut. Last year suburban traffic amounted to 356,000,000 passengers, of whom the railways carried 257,000,000.

Telegraph and Telephone Notes.

A British Empire Exhibition Telegraphic Record.—THE KING'S EMPIRE MESSAGE.—A great telegraphic feat was performed in connection with the King's opening of the Exhibition. It was arranged that immediately after opening the Exhibition the King should hand in a 12-word telegram conveying his announcement of the fact to the whole Empire by the Post Office, the Pacific Cable Board, and the Eastern and Associated Telegraph Companies. A wire was joined up from the Wembley Exhibition Stadium office to the Central Telegraph Office in close proximity to the Imperial cables. A second line was joined by the side of it to the Eastern and Associated Telegraph Co.'s office in Moorgate Street, and the message sent round the Empire from east to west. Thus the route was Wembley; Central Telegraph Office; Halifax, Nova Scotia; Montreal; Bamfield, Vancouver; Fanning Island; Fiji; Auckland, New Zealand, and Sydney. At that point the work of the Post Office, the Imperial cable, the Canadian Pacific Railway, and the Pacific Cable Board came to an end. The message was then telephoned across Sydney to the offices of the Eastern and Associated Telegraph Companies, and on the homeward journey it came by three routes simultaneously and for a portion of its journey by four routes. It went to Cocos, Rodriguez, Durban, Cape Town, St. Helena, Ascension, St. Vincent, Madeira, and also from Sydney to Singapore, Madras, Bombay, Aden, Suez, Alexandria, Malta, Gibraltar. Thus it came home by a triple route to England, and the office of the Eastern and Associated Telegraph Companies had the curious experience of receiving the message almost simultaneously to a second by four different routes.

At the Stadium office at Wembley Post Office officials had the interesting duty of watching two telegraph instruments, on one of which the message went out immediately the flags were unfurled, whilst at the other in the space of 80 seconds the message was received after having gone round the world. Then, written on an Eastern Company's telegraph form, it was delivered by a Post Office messenger, and a map of the route was enclosed for the information of the King.

Practically the whole route, with 17 transmissions on the direct journey, was worked by Wheatstone or by adaptations of Wheatstone to siphon working still using the Wheatstone transmitter.—*Telegraph and Telephone Journal.*

Continental Radio Service.—SPECIAL OLYMPIC GAMES ARRANGEMENTS.—In connection with the Olympic Games that are being held in Paris from May 3rd to July 27th, the Marconi Co., in conjunction with La Compagnie Radio-France, has arranged for special facilities for the rapid transmission of telegrams between Paris and London. A quadruple Baudot service has been installed between the Colombes Stadium Government Telegraph Office and the offices of La Compagnie Radio-France in Paris, whence the messages will immediately be transmitted by wireless to London for delivery.

International Telephony.—PARIS CONFERENCE.—Representatives of the European powers met in Paris on April 29th with a view to creating an International Advisory Committee on long-distance telephony in Europe. Three sub-committees were appointed to examine technical questions. Their labours lasted the whole week. Colonel T. F. Purves, engineer-in-chief to the British Post Office, represented Great Britain.—*Daily Mail.*

Mexico.—NEW RADIO STATIONS.—The Mexican Government intends to substitute in its radio-telegraphic installations the continuous wave for the spark system. It appears that it had already arranged contracts in Germany for four stations of this kind at a cost of one and a half million pesetas. These stations will be set up at Merida, Vera Cruz, and Tampico. The stations of the old type at these places will be transferred to the Islas Marias, La Paz (in Lower California), Guadalajara (in Jalisco), Acapulco, and to the State of Guerrero.

Sweden.—TAXI-CAB RANK TELEPHONES.—The following arrangements have just been installed in Norrkoping (pop. 60,000) to obviate the trouble which the public experienced in telephoning for taxicabs; it often happened that one had to ring up three or four cab ranks before finding one with an available taxi. Under the new arrangement the "Cab Union" pays the telephone authority for two telephonists in the local exchange to deal with "cab calls" at a special "cab position." There are nine cab ranks, each for 23 cabs, at each rank there is a c.b. instrument associated with three jacks. When a plug is inserted in a jack the line is completed through a 3,000-ohm resistance. Each chauffeur is provided with a plug, and it is his duty to insert the plug in a jack when he is free at the rank. The "cab operator," by pressing a key, causes "marking" lamps associated with each rank to light, if a plug is in any jack at the rank. This shows where there are cabs free. Each line from the rank has also an ordinary calling lamp for the receipt of calls made from the rank.

There are two transfer lines in the outgoing junction multiple, so that when a subscriber asks for "cabs," the answering telephonist puts the caller through to the "cab operator"; this operator presses the "marking" key and ascertains at which ranks cabs are free, and chooses the rank nearest the calling subscriber. The "cab operator" has in front of her a map showing the nine cab ranks, and a list of the streets, showing which are the first, second, and third most suitable ranks. The public can order cabs in advance, the orders being ticketed and then passed on to the relative rank 10 minutes before the cab is required.—*Svensk Trafik-Tidning.*

The Telephone Service.—INCREASED CALLS.—The Post Office Telephone Department states that in 1923 local calls increased from 710,000,000 to 803,000,000, and inland trunk calls increased from 56,362,000 to 66,543,000, while the number of stations was 102,000 more on December 31st, 1923, than on the same date in 1922.

RATE REDUCTION.—Mr. P. Snowden, Chancellor of the Exchequer, in introducing the Budget in the House of Commons on April 29th, announced that certain Post Office reductions would be proposed by the Postmaster-General. These, as set out in a White Paper, are that local telephone calls (3 miles) will be reduced from 1½d. to 1d., and calls of from 5 to 7½ miles will be reduced from 2½d. to 2d. Concurrently the discount of 5 per cent. on calls in excess of 2,000 per annum will be abolished; certain day trunk call fees will be reduced, the scale of charges for removals will be modified, and various other reductions made in charges. The proposed alterations will result in a loss of revenue of £500,000 in 1924-25, or of £1,000,000 in a full year.

Radio Notes.

Belgium.—BRUSSELS STATION.—The radio broadcasting station at Brussels was closed from May 5th to 8th inclusive. Transmission is to recommence on May 9th, when a new wavelength is to be employed, probably between 220 and 280 metres, the exact length depending on trials which are to be made.—*Daily Mail.*

Brazil.—BROADCASTING STATIONS.—Permission to establish four radio broadcasting stations has been granted by the Ministry of Public Works of Brazil to the Brazilian Radio-telegraph Co. The four stations are to be located at Sao Paulo, Bello Horizonte, Bahia, and Pernambuco.—*Commerce Reports.*

Edinburgh Station.—OFFICIAL OPENING.—On Thursday, May 1st, the British Broadcasting Co.'s Edinburgh station was inaugurated officially at 9 p.m. The call signal of the new station is 2 EH, and its wave length 325 metres.

France.—LA UNION FRANCAISE.—A new association has lately been formed in Paris (35, Rue Tourneport), with the title of La Union Française T. S. F., to popularise the radio movement in France.

Honolulu.—NEW BROADCASTING STATION.—According to an announcement by the director of the Pan-Pacific Union at a recent meeting at New York, a radio broadcasting station is being established in Honolulu from which programmes in English will be broadcast to islands of the Pacific and Orient.—*Reuter.*

Liverpool Relay Station.—SITE CHOSEN.—The B.B. Co. has definitely decided on the site for the Liverpool relay station, and already work has been commenced with a view to the station being opened by June 1st. The director of the station will be Mr. H. Cecil Pearson, at present assistant director at the Birmingham station, and he will assume his duties in Liverpool within a fortnight, with an assistant and three engineers. For the aerial support the chimney of Messrs. Milner's Safe Works has been adopted, while the aerial itself will be of the cage pattern.

Loud-Speakers at Wembley.—BROADCAST MUSIC.—Wherever visitors wander in the pleasure grounds of the British Empire Exhibition they will never be out of the range of music reproduced by loud-speakers installed on the Western Electric "Public Address" system, the familiar horns being in many cases cleverly concealed.

United States.—STANDARD FREQUENCY TRANSMISSIONS.—The Bureau of Standards is transmitting special signals of standard frequency about twice a month which can be heard and utilised in general east of the Mississippi River. These

special signals are of use for testing, standardising wave meters, and adjusting transmitting and receiving apparatus. The transmissions on May 20th and June 5th will be of special interest to ship operators, those on July 7th to amateurs, and those on June 20th to broadcasting station operators. The accuracy of these signals is within three-tenths of one per cent. Information on how to use them and more detailed information is given in Letter Circular No. 92, which may be obtained, on application, from the Bureau of Standards, Washington, D.C. All transmissions are by unmodulated continuous-wave telegraphy. A complete frequency transmission includes a "general call," a "standard frequency signal," and "announcements." The "general call" is given at the beginning of an eight-minute period, and continues for about two minutes; it includes a statement of the frequency. The "standard frequency signal" is a series of very long dashes with the call letters WWV intervening; this signal continues for about four minutes. The "announcements" are on the same frequency as the "standard frequency signal," and contain a statement of the measured frequency. An announcement of the next frequency to be transmitted is then given, followed by a four-minute interval while the transmitting set is adjusted for the next frequency.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Aberdeen.—May 21st. Electricity Department. Excavating, pipe laying, concrete work, &c., in connection with the extension of the circulating water system of Ferryhill power station. (See this issue).

Australia.—MELBOURNE.—June 24th. Postmaster-General's Department. Telegraph equipment.*

Belgium.—May 21st. Belgian Post and Telegraph authorities at La Salle Madeleine, Brussels. Supply of cable in the Antwerp district. Particulars (Cahier des Charges Special No. 3-12) for 4 fr.

The municipal authorities of Molenbeek-Saint Jean, Brussels, have this week invited tenders for the supply of 1,000 electricity meters.

May 14th. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de la Charité, Brussels. 132,000 metres of insulated cable in five lots, 368,000 metres of insulated wire in four lots, and one lot of 33,000 metres of specially insulated bronze wire. Particulars (Cahier des Charges Special No. 1,388) for 1 fr. 40 c.

May 24th. Belgian Direction General of the Ministry of National Defence, 10, Rue du Méridien, Brussels. Electric power installation, including transformer cabin, at the State munition works at Zwyndrecht. Particulars (Cahier des Charges No. 8,022) for 4 fr.; copies of drawings, 4 fr.

May 15th. Municipal authorities of Muysen-lez-Saint Trond (Province of Limbourg). Establishment of a l.p. electricity distribution system in the town. Particulars for 9 fr.

Birmingham.—Board of Guardians. Electric wiring, &c., installation at the Selly Oak Hospital. Specifications, &c., from Messrs. Edwards & Shaw, Colmore Row, Birmingham.

The Corporation Electric Supply Department is inviting tenders from electrical wiring contractors for the installation of electric lighting in approximately 2,000 houses erected, or to be erected, on various Corporation housing estates.

Castlebar.—May 15th. County of Mayo Mental Hospital. Heavy oil engines; dynamos; storage battery; switchboard; and wiring mains and fittings. Chairman of Committee, Mental Hospital, Castlebar.

Colchester.—June 2nd. Electricity Department. Generating plant. For full particulars see our issue of April 25th.

Dundee.—Town Council. Supply of 100 tons B.S.S. No. 7 tramway rails, 1,000 tie bars, 10 tons fishplates, 1 ton fishplate bolts and nuts. Particulars from Mr. Geo. Baxter, M.Inst.C.E., city engineer.

Edinburgh.—May 19th. Electricity Supply Department. E.h.p. switchgear for sub-stations, 3-phase transformers. (May 2nd.)

Enniscorthy.—June 10th. Urban District Council. Generating sets, switchgear, storage battery, overhead mains, oil storage tank, and overhead travelling crane. (See this issue.)

Hull.—May 15th. Electricity Committee. Electric lighting installation at the new turbine house and boiler house, Sculcoates electricity works. (See this issue.)

Jamaica.—August 1st. Colonial Secretary. Licence for the establishment of a telephone system in Kingston and St. Andrew, Jamaica. (See this issue.)

Kirkcaldy.—May 26th. Electricity Works. Cables and roadwork. (See this issue.)

Knaresborough.—Urban District Council. Static sub-station equipment, h. and l.p. cable, networks, transformer kiosks and transformers, service cables, &c. (See this issue.)

London.—H.M. OFFICE OF WORKS.—May 16th. Steel conduit and fittings for electric wiring. (See this issue.)

INDIA STORE DEPARTMENT.—May 27th. Telegraph insulators, porcelain, screwed-pattern telephone repeater equipment. (See this issue.)

Maesteg.—May 27th. Urban District Council. L.p. overhead and underground distributing mains, switchgear, and suspension lighting of highways. (April 25th.)

Manchester.—May 28th. Electricity Committee. Twelve months' supply of cables, potential and current transformers, electricity meters, and time switches. (See this issue.)

New Zealand.—WELLINGTON.—June 17th. Public Works Department. Oil switches, relays, and current transformers for the Lake Coleridge scheme.*

June 24th. Twelve electric ranges for the Mangahao power scheme.*

July 15th. Twelve sub-station transformers for Waikato.*

Penang.—GEORGE TOWN.—May 20th. Municipal Commissioners. One 3,000-kW turbo-generator and condensing plant. (April 25th.)

Portsmouth.—Electricity Supply Department. Seven 500-kVA, 6,000/11,000-V, single-phase transformers; twelve 100-kVA, 3-ph. transformers, 11,000/400-V; two 200-kVA banks Scott-connected transformers, 11,000/200 or 100-V; two 200-kVA banks Scott-connected transformers, 11,000/1,000-V (See this issue.)

Sheffield.—June 3rd. Electricity Department. Plant required in connection with the new generating station. For particulars see our issue of May 2nd.

Slaithwaite.—May 31st. Urban District Council. Four-core cables and joint boxes, service connections and pillars, street lighting cables and lantern fittings, sub-station switchgear and equipment, house service meters. (May 2nd.)

South Africa.—JOHANNESBURG.—June 14th. Municipal Council. Motor converter and three rotary converters.*

KINGWILLIAMSTOWN.—July 8th. Borough Council. Electrical plant, steam-raising plant, steel buildings, h.p. cables.*

NATAL.—May 17th. Corporation. Five miles of single tram track, complete with bonds. Mr. F. L. Davis, borough engineer, Durban.

Southampton.—May 26th. Electricity Department. Coal-handling plant and bunker extensions, &c. (May 2nd.)

South Shields.—June 4th. Electricity Supply Department. One 6,000-kW turbo-alternator set and condensing plant. (See this issue.)

Thurles.—May 30th. Urban District Council. Crude oil engines, switchgear, distribution system, buildings, &c. (See this issue.)

Uruguay.—MONTEVIDEO.—June 17th. Port authorities. Electric winch and capstans.*

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Belgium.—Only two tenders were received last week by the Belgian Post and Telegraph authorities in Brussels for the supply of 2,000 microphones and 2,000 bell sets, with condensers, in connection with the telephone service. The lowest offer for both lots was that of the New Antwerp Telephone and Electrical Works, Ltd., of Antwerp, who quoted 132,000 fr. and 98,000 or 138,000 fr. respectively for lots 1 and 2, as against 140,000 fr. by the Bell Telephone Manufacturing Co., of Antwerp, for lot 1, and 106,000 fr. or 146,000 fr. for lot 2.

Keen international competition took place last week for the supply of a number of rotary transformer sets for the municipal authorities of Ixelles, Brussels, offers being received from seven concerns—three Belgian and one each from Luxemburg, Sweden, Switzerland, and Holland. The prices ranged from 162,205 fr. to 420,000 fr., the lowest bid being that of the Société Luxembourgeoise pour Entreprises Electriques, of Luxemburg, who quoted 162,205 fr. and 214,030 fr. per set.

Glasgow.—Tramway Committee. Recommended:—

Steel pinions.—W. C. Yuille & Co., Ltd.
Axles.—Glasgow Railway Engineering Co., Ltd.
Tires.—Steel Co. of Scotland, Ltd.
H.p. cable.—Siemens & English Electric Lamp Co., Ltd.; and Western Electric Co., Ltd.

Corporation. Recommended:—

Electric lighting and bell installation at the physician-superintendent's house at Belvidere Hospital (£77).—Mr. D. Henderson.

Housing Committee. Recommended:—

Electric lighting installation at the Kelvindale housing scheme (£1,982).—Mr. David Henderson.

Electricity Committee. Recommended :—

Ironwork of the disk screens for the Dalmarnock power station (£296).—W. Baird & Sons.

Sub-station transformer in connection with the Kelvindale housing scheme (£200).—W. Taylor & Son (Glasgow), Ltd.

Two 400-kVA transformers for Kelvindale and Norham Street sub-stations (£970).—British Electric Transformer Co., Ltd.

One ditto ditto (£412).—Fuller's Electric & Mfg. Co., Ltd.

France.—Among the new contracts recently secured by the Société Générale d'Entreprises Electriques, of Paris, are those for the electrification of the Paris-Orleans and P.L.M. railways.

Japan.—Recent orders placed with the International General Electric Co. through their representatives, the Mitsui Co., of Japan, cover a total of 78 2,000-kVA transformers. The last order, placed by the Tokio Electric Light Co., covered 23 2,000-kVA, 50-cycle, single-phase units, with a voltage rating of 22,000/11,000 to 3,450. This is the second order placed with the International Co. covering this rating of transformer. The previous order, which has been shipped, covered 55 similar units.

Kingston-on-Thames.—Town Council. Accepted:—

3,000-kW turbo-alternator, complete with condensing plant and all auxiliaries (£20,437).—Brush Electrical Engineering Co., Ltd.

30,000-lb. water-tube boiler, inclusive of foundation (£9,849).—Vickers-Spearing Boiler Co.

London.—Morden.—The Underground Electric Railways Co. of London has placed two important contracts with Messrs. Charles Brand & Son and the Foundation Co., Ltd., for the driving of tunnels on the extension of the City and South London Railway from Clapham Common to Morden. Messrs. Brand will undertake the section between Clapham Common and the north end of Tooting Broadway station, while the Foundation Co. will be responsible for the section of the line to Dorset Road, Morden. The contracts amount together to about £600,000. The total cost of constructing and equipping the Morden extension will be £3,500,000.

Salford.—Health Committee. Accepted:—

One Chloride battery, 795-Ah capacity, for the Nab Top Sanatorium (£625, less £63 for old materials).—Chloride Electrical Storage Co., Ltd.

Electricity Committee. Accepted :—

3,778 yd. e.h.p. cable (£2,919); 320 yd. e.h.p. and h.p. cable (£98).—W. T. Glover & Co., Ltd.

500 yd. l.p. cable (£355).—Macintosh Cable Co., Ltd.

1,000 yd. l.p. cable (£261).—Hackbridge Electric Construction Co., Ltd.

Forthcoming Events.

British Industries Fair.—May 12th-23rd. At the Castle Bromwich Aerodrome, Birmingham.

Institution of Civil Engineers.—Tuesday, May 13th. At the Institution, Great George Street, S.W. At 6 p.m. Annual general meeting.

Royal Society.—Wednesday, May 14th. At Burlington House, Piccadilly, W. At 8.30 p.m. Conversazione.

Radio Society of Great Britain.—Wednesday, May 14th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6 p.m. Discussion on "Some Suggested Lines for Experimental Research," by Mr. C. G. Blake.

Institution of Railway Signal Engineers.—Wednesday, May 14th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 6.30 p.m. Discussion on "Mechanical and Electrical Detection."

Royal Institution of Great Britain.—Thursday, May 15th. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "Atmospheric Interference in Wireless Telegraphy," by Dr. E. V. Appleton. (Lecture I.)

Electrical Power Engineers' Association (Kent Section).—Saturday, May 17th. At Hollingworth Hall, Church Institute, Maidstone. At 6 p.m. Lecture on "Combustion and Boiler-house Efficiency," by Mr. J. N. Waite.

The "Electrical Review" Service Department.

We should be glad to learn the names of makers or suppliers of :—

Lyons Liquid Resistances.
Arrowhead tape.
Rheostan wire.

Notes.

X-ray Study of Steel.—In a paper presented to the Iron and Steel Institute two years ago Dr. Arne Westgren and Gösta Phragmen (of the Metallographic Institute, Stockholm), communicated some results of the application of X-ray methods to the study of the crystal structure of steel, including a series of powder photograms of the α, β, γ, and δ forms of iron was reproduced. All attempts to get a photogram of the last modification in a pure state had, however, failed; its interference lines were intermingled with lines originating from the γ modification.

This deficiency has now been overcome by making some slight changes in the arrangement for taking high-temperature photograms. Above all, the length of the heated iron rod has been increased, in order to get a more uniform temperature at its centre. The new photograms, according to a paper read at the annual May meeting of the Institute, fully confirm the conclusions drawn from the former investigations, but the authors have still not been able to solve the question of how the atoms are grouped in cementite. The powder photogram of cementite contains a very large number of lines, some of which flow into one another. As many of the possible interferences of this orthorhombic substance practically coincide, it cannot be settled definitely, without a more thorough experimental investigation, to which of the net planes the lines of the powder photogram correspond. In the previous paper triplet indices were assigned to the lines, but it could not be decided if these index combinations were correctly determined in all cases. To settle this question, which is of fundamental importance for the unravelling of the atomic grouping, so-called "complete or rotation photograms" have been taken of a cementite crystal with a special camera made for the purpose.

A special camera was constructed for the purpose of an exact establishment of the lattice dimensions, which has enabled considerable improvement to be made in the exactitude of such measurement.

Fused Quartz.—A way has been found of making clear fused quartz in large quantities at a cost low enough to render its commercial manufacture practicable. At Lynn, Massachusetts, says *The Times*, the General Electric Co. exhibited quantities of this fused quartz in a variety of forms and in an amount larger than has ever been seen in one place before. It has many valuable qualities, and may be of great use in medicine and surgery.

Fatalities.—The inquest was concluded at Middlesbrough on April 23rd on Chas. Barlow, of Forrest Place, South Bank, chief electrician at the Cargo Fleet Ironworks. It was stated that on April 18th tests were being carried out preparatory to a mill being put in operation when Mr. Barlow's overcoat caught in the rollers and he was dragged down, his right arm being crushed. He became unconscious and was taken to the North Ormesby Hospital, where he died the following day. A verdict of "Accidental Death" was returned.

An inquest was held at the British Thomson-Houston Co.'s works, Rugby, on April 29th, into the death of Lewis Slattery, which occurred on April 26th. Messrs. H. N. Sporborg (managing director), R. Dumas (works manager), H. R. Rogers (Inspector of Factories), and A. L. Tackley (Divisional Electrical Inspector of Factories) were in attendance. It was stated in the course of evidence (as reported in the Rugby *Advertiser*) that the deceased had been with the B.T.H. Co. since 1917, and was employed in the test department. A charge hand said that he had instructed Mr. Slattery to wear rubber gloves and shoes before commencing a dangerous experiment, but apparently he neglected this precaution. Deceased was conducting a test on some machines at a pressure of 3,000 V when, according to a witness, he lost his balance and came into contact with a "live" part, receiving a fatal shock. Artificial respiration was resorted to without success, and a medical witness gave the opinion that death was instantaneous. The Coroner said that this was a very simple case; he feared that it was due to nothing else but youthful carelessness. The jury returned a verdict of "Accidental death," expressing the view that no one was to blame but the deceased man himself. They considered, however, that dangerous spots should be protected by a wire guard, and it was stated that the company already had the matter under consideration. On behalf of the company, Mr. Lupton Reddish expressed regret at the occurrence and sympathy with the relatives.

Joseph Yardley, aged 52 years, erector, of Hadfield, Derbyshire, employed by the English Electric Co., was working on a transformer at the Squire's Gate sub-station, St. Annes-on-Sea, when he received a fatal electric shock. The fingers of his left hand were burned.

The Electrical Trades Benevolent Institution.—Annual Report and Accounts.—We have received the E.T.B.I. booklet for 1924, containing the report of the committee and the accounts for 1923, the report of the annual general meeting, and the report of the annual festival of 1923, together with a list of governors, members, subscribers, and donors, and the rules, from the hon. secretary, Mr. F. B. O. Hawes, A.M.Inst.C.E., M.I.E.E., 18 & 21, Park Mansions, South Lambeth Road, S.W.8. The annual report shows that the income from contributions was £1,698, making, with the receipts from dividends and other sources, a total of £2,682. A sum of £1,967 was carried to capital account, and during the year £2,933 was invested, bringing the total of the invested funds at cost to £21,732. The number of applications for assistance was again larger than in any previous year; every person who applied and who was qualified for assistance received it. The Local Advisory Committees at Cardiff, Manchester, Newcastle, and Glasgow, were very helpful, and it is hoped that such committees will be formed in other large towns. More collectors are wanted, and the heads of firms are invited to encourage such appointments. The annual festival was presided over by Sir Philip Nash, K.C.M.G., C.B., whose appeal brought in £1,350. The committee again draws attention to the advantage of membership, not only for the member's own benefit, but also to help others; the subscription is 10s. per annum.

(Continued on page 758.)

Some of the Exhibits at Wembley.

The Cambridge & Paul Instrument Co., Ltd.

(Stand No. 79, Avenues 11 & 12, Bays 22 & 23.)

ONE of this company's principal exhibits is the "Thomas" recording meter for gas and air. This is a compact apparatus which will give, under commercial conditions, continuous measurements of gas flow with a high degree of accuracy.

The measurements are automatically integrated and recorded directly in terms of standard cubic feet at standard pressure and temperature (30 inches of mercury and 60 deg. Fahrenheit, saturated) so that the labour of observing the pressure, temperature and humidity conditions in the pipe line and the risk of errors in the computation of the corrections are eliminated.

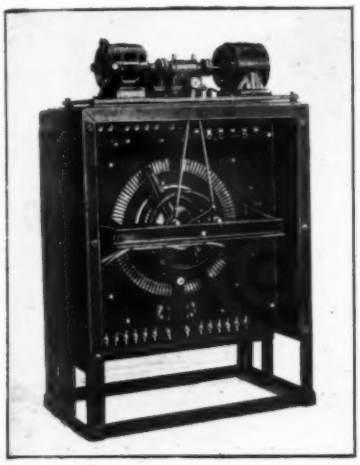

Fig. 41.—Front View of Regulator.

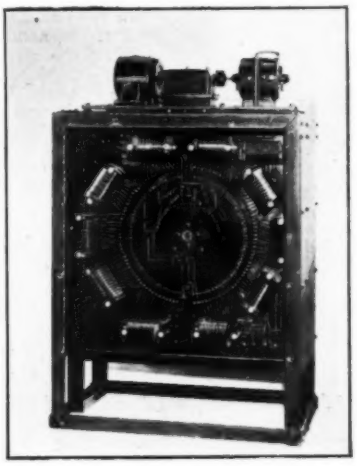

Fig. 42.—Back View of Regulator.

The "Thomas" Gas-recording Meter.

The fundamental principle of the Thomas meter is based on the fact that the specific heat per cubic foot is almost the same for all the gases which occur in gas practice. It follows that if gas flowing through a duct is raised in temperature by a fixed and constant amount by means of a heater in the duct, the quantity of heat thus introduced is a measure of the quantity of gas flowing. The temperature of the whole of the gas passing through the Thomas meter is increased two degrees Fahrenheit by means of an electric heater, and the power thus dissipated by the heater is measured by accurate electric meters calibrated so as to read directly in standard cubic feet of gas. A complete installation consists of a housing inserted directly in the pipe line and electrically connected to a regulator and an instrument panel, which may be some distance away. The housing contains the heater and two electrical thermometers, used differentially for controlling the temperature rise. It is made in two types, the return flow type, for installations up to and including 150,000 cu. ft. per hour capacity, and a vertical type, for larger capacities.

The current through the heater is adjusted by means of the regulator, front and back views of which are shown in figs. 41 and 42. Under normal conditions—when the temperature of the gas, as measured by the outlet thermometer, is exactly 2 deg. F. above the temperature as measured by the inlet thermometer—a Wheatstone bridge, of which the thermometers form two arms, is balanced, and the galvanometer pointer takes up the neutral, or null position. Should a change occur in the gas flow this two-degree difference in temperature will not be maintained, and the bridge circuit will become unbalanced. The galvanometer needle will thus be deflected and will close an electric circuit, causing the regulator to adjust the heater current by the requisite amount to restore the two-degree temperature rise and thus to rebalance the bridge.

Current for the motor and heater is obtained from the general supply available; either alternating or direct current may be employed (110 or 220 volts). A generator, mounted with the motor on the top of the regulator, furnishes the d.c. supply required to operate the Wheatstone bridge circuit and the electromagnets.

The instrument panel (fig. 43) is mounted on a pedestal. It accommodates the galvanometer for the Wheatstone bridge circuit and the integrating and recording wattmeters, together with suitable switchgear. The galvanometer is of the suspended moving-coil type; it is robust in construction and, at the same time, highly sensitive. The moving system is contained in a dust-tight metal case, which also accommodates the ratio arms of the Wheatstone bridge circuit. An integrating wattmeter measures the energy expended in the heater to raise the temperature of the flowing gas 2 deg. F., and a recording wattmeter records its variations on a chart.

A combined CO_2 and CO outfit is exhibited. This has a simple indicating outfit consisting of a CO meter panel, connected to an indicator, together with a CO_2 meter, soot filter, and aspirator. Current is supplied by a 6-volt accumulator. The panel (fig. 44) accommodates a CO meter (of smaller construction than the CO_2 meter), a wash bottle, a small electrically-heated catalyst furnace, a rheostat, and a switch. Both CO_2 and CO meters are connected to the indicator, which has two scales, calibrated to give direct readings of CO_2 and CO percentages respectively, the standard ranges being 0-20 per cent. CO_2 and 0-10 per cent. CO. The CO_2 percentage of the flue gas is first measured by the CO_2 meter, and the gas is then directed through the wash bottle and through one cell of the CO meter into the furnace, where the carbon-monoxide is converted into CO_2, the converted gases being finally passed through the second cell of the CO meter. The meter therefore measures the difference in the CO_2 content of the gases caused by their passage through the furnace. This difference depends upon the amount of CO originally present, and is shown on the indicator scale as a definite CO percentage. Since the gas passes in succession through both meters, only one soot filter and one aspirator are required. The indicator is fitted with a 2-way switch, enabling readings of either CO_2 or CO percentage to be obtained at will. By using a four-point indicator, CO_2 and CO percentage at two points can be measured on one instrument. Combined indicating and recording outfits, for one, two, or three points, can also be supplied. It is also possible to obtain indications or records of CO_2, CO, and temperature on one instrument.

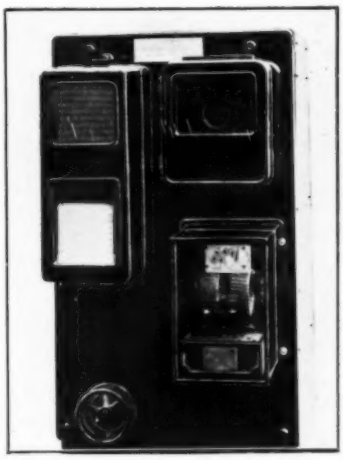

Fig. 43.—Instrument Panel of "Thomas" Meter.

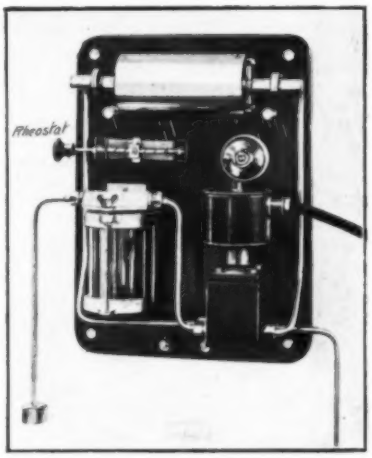

Fig. 44.—CO Meter Panel.

The company also has on its stand combined electrical CO_2 and temperature indicators and recorders, dial draught and

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pressure gauges, draught and pressure recorders, pressure and vacuum recorders, indicating and recording thermometers of the mercury-in-steel type, thermo-electric, resistance, radiation, and optical pyrometers, stator and rotor temperature outfits, pyrometer testers and potentiometers, stress recorders, micro-indicators, fuel calorimeters, electrical instruments for a.c. and d.c. measurements, and other precision instruments. Fig. 45 illustrates a typical CO_2 recorder. In addition to these there are Cambridge instruments in many other parts of the Exhibition. Among these may be mentioned the installations supplied for each of the four boilers of the power station. These comprise a panel containing an electrical CO_2 indicator, a dial draught gauge and an index thermometer with capillary tubing and rigid steel stem to measure the flue gas temperatures. In the boiler house a panel accommodates a two-point electrical CO_2 recorder, a pressure recorder for recording the pressure in the main steam pipe, a draught recorder, and a six-point electrical distance indicator connected to thermometers measuring inlet and outlet economiser feed water, inlet and outlet flue gas, and steam temperatures. In the engine room, in connection with the turbine plant supplied by Messrs. Jas. Howden & Co., Ltd., the company has installed a 12-point electrical distance thermometer outfit with thermometers for measuring temperatures at the following points: Stop-valve boiler side, turbine exhaust, h.p. bearing oil outlet, l.p. bearing oil outlet, first generator bearing oil outlet, second generator bearing oil outlet, oil cooler oil outlet, oil cooler oil inlet, oil cooler water inlet, and oil cooler water outlet. In addition, there are a pressure recorder for determining the steam pressure at the stop-valve (boiler side), and a combined pressure and vacuum recorder for measuring the pressure at the turbine exhaust. A 6-point totally-enclosed indicating outfit has been supplied for the condenser plant, with thermometers measuring steam, inlet and outlet circulating water, and condensate temperatures. In the sub-station there are two index thermometers with 8-inch diameter dials and three with 13-inch dials measuring transformer oil temperatures.

In addition to the above apparatus, Cambridge & Paul outfits are being supplied to many other firms in connection with their exhibits.

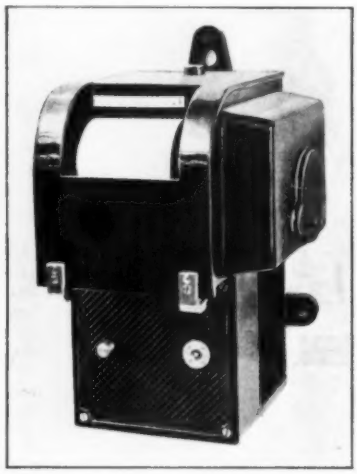


Fig. 45.—Cambridge & Paul CO_2 Recorder.

Brookhirst Switchgear, Ltd.

(Stand No. 99, Avenue 13, Bays 15 and 16.)

The scope of the firm's exhibits is briefly defined as electric motor control gear possessing the following characteristics:—Suitability for normal industrial applications and for use by unskilled operators, and compliance with the principle that all the control gear for a single motor shall form part of one ironclad unit.

The direct-current, hand-operated gear comprises primarily panels of the drum and multiple-lever types, which differ from one another only in respect of the starter and possess the following common features: The glazed inspection doors are so interlocked with the double-pole isolating switch that they cannot be opened or left open unless the switch is "off." The two magnetic blowout contactors, in conjunction with the two overload trips, provide complete no-volt and overload protection on both poles. The shunt regulator is so interlocked with the contactors that it is impossible to start up the motor with a weak field. The motor armature circuit is broken under all conditions by the contactors and never upon the starter contacts.

The drum-type starter (fig. 47) is fitted with the "Brookhirst" patent "slow motion" ratchet handle mechanism. With this mechanism the proper sequence of starting operations must always be carried through, and if it be interrupted a new start can only be commenced after the drum has been manually returned to "off." For the larger sizes of hand-operated panel, the multiple lever type starter is employed.

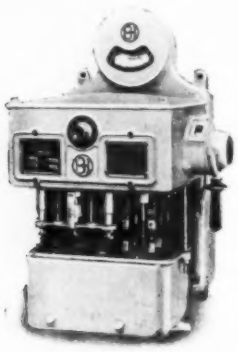


Fig. 46.—Multi-switch Type Star-delta Motor Controller.

The faceplate type starters are similar to the drum type.

The direct-current automatically-operated equipment shown comprises panels of the solenoid type for small and medium capacities, and of the contactor type for the larger powers. The solenoid type panels are, except for the starter, similar to the hand-operated panels already described. These automatic panels, however, embody a starter of the solenoid type.

The solenoid type panels are supplied both for constant and variable speed. The variable speed panel is made in three types. The "hand regulation" type is suitable for conditions involving frequent speed regulation but only occasional starting and stopping. The "automatic acceleration" type embodies a hand-operated shunt regulator operating in conjunction with an automatic accelerator. The "automatic regulation" type

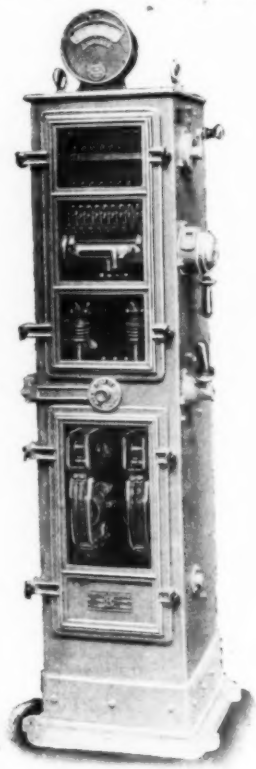


Fig. 47.—Drum Type Variable Speed Panel.

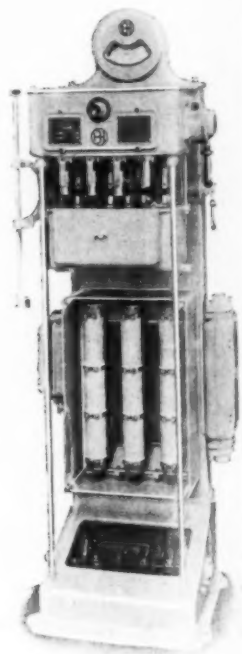


Fig. 48.—Rotor Starting Pillar with Isolating Switches.

embodies a solenoid-operated shunt regulator actuated from a push-button station near the operator. It is suitable for both frequent starting and frequent speed adjustment.

The contactor type panels comprise a series of contactors, the closing of which is controlled by a solenoid type master switch. Fundamentally the arrangement of these gears is the same as that of the solenoid type panels.

The alternating current, hand-operated gear consists of oil-immersed control units of the multi-switch type in four forms, straight-on, star-delta (fig. 46), auto-transformer, and rotor. As in the d.c. control gear, a single ironclad unit suffices for the control of one motor. This unit consists of a starter and a circuit breaker. The several switches of the multi-switch control unit are operated by a single ratchet handle, which closes first the circuit breaker and then, in correct sequence, the starting switches.

The pillar type gears are made with (fig. 48) and without isolating switches. These switches are of the air-break type, but the oil-immersed circuit breaker is always tripped before the isolator opens.

For a.c. automatic operation a range of gear has been designed on parallel lines to that just described. A range of midget control gear has been developed and examples are on show.

Among the other equipment exhibited are drum type starting panels for marine duty; a special double-pole drum-type starter for use on H.M. ships, with single pole contactor, and a "Brookhirst" battery-charging panel.

Messrs. C. A. Parsons & Co., Ltd.

(Stand No. 5, Avenues 8 & 9, Bays 18-19-20.)

The principal exhibit of this company is a 12,000-kW, 3,000-r.p.m. tandem turbo-alternator and exciter, designed for railway traction (fig. 49). The plant is one of five sets with surface condensers constructed during 1923-24 for the Union of South Africa Electricity Supply Commission. These sets will be erected in the new power station at Colenso, Natal, for the electrification of the railway between Glencoe and Pietermaritzburg. Each set is capable of supporting an overload momentarily of 20,000 kW, and is similar in design to the 15,000-kW, 3,000-r.p.m. sets recently exported by the company to the Victoria Electricity Commission for the electrification of the Melbourne Suburban Railways.

The blading of the h.p. and l.p. cylinders is of steel throughout; that in the h.p. cylinder being of the "end-tightened" type. In this type of blading, which was introduced commercially in 1912, the necessary running clearances are maintained in an axial direction instead of radially, so that they can be made small and adjusted and regulated under the control of the thrust bearing which determines the position of the shaft axially in its cylinder. The minimum radial clearance is ¼ in. The low-pressure cylinder is designed on the double-flow principle, and has reaction blading of the thin-tipped type. The blade root fixing is effected by the interlocking of serrations machined on the blade units, with corresponding serrations on the sides of the blading grooves. The alternator and exciter embody the latest practice in high-speed design. The stator is built in one piece, and wound so that it can be shipped complete. The rotor is made from a single forging with distributed windings embedded in radial slots, milled out of the solid.

There are two show cases, one exhibiting examples of the latest form of turbine blading adopted by the company, together with interesting examples of machine work, and the other containing sample pieces of the various constructional, electrical, and insulating materials used in the manufacture of generators.

Another interesting exhibit is a 1/12 scale model of a 50,000-kW turbo-alternator and condensing plant which is now nearing completion at the works, and will be erected in the new 500,000-kW station at Crawford Avenue, Chicago, U.S.A. In order to show the lay-out of the plant in relation to the engine room, the model includes basement, walls, roof, and crane. Some idea of the size of the station will be gained from the fact that the crane-rail span is 122 ft., and the height from basement to the apex of the roof is 113 ft. The model is 9 ft. 5 in. high, 7 ft. 10 in. wide, and 11 ft. 3 in. long, and is specially illuminated in order to show all details of design clearly. Messrs. G. & J. Weir supplied the models of the boiler and condensing plant auxiliaries, which they are manufacturing.

A second model shows a geared turbine power installation in a Lancashire cotton mill.

An exhibit of considerable historical interest is a small .5-kW direct-coupled turbo-dynamo, running under steam at about 9,000 r.p.m. It was built some thirty years ago, and is of similar type to the first Parsons machine of 1884 which is now in the South Kensington Museum.

The turbine is arranged on the double-flow principle; and the speed is regulated by a combined mechanically- and electrically-operated governing mechanism of great ingenuity.

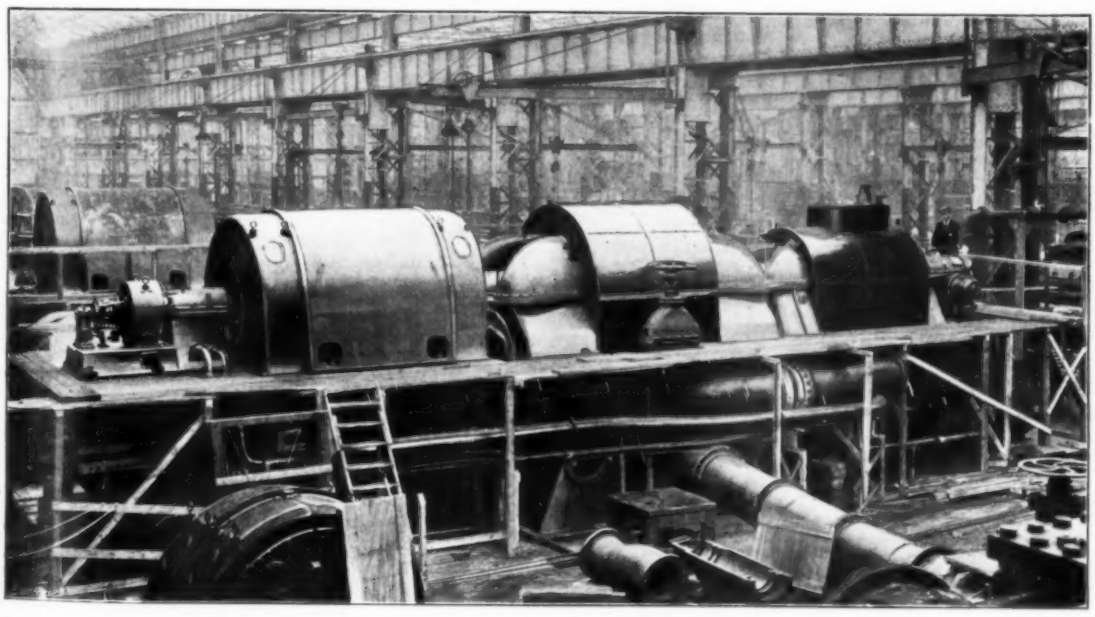


Fig. 49.—Parsons 12,000-kW, 3,000-r.p.m. Tandem Turbo-Alternator.

A spare turbine shaft, complete with its blades, is exhibited by the side of the set. The dynamo is a shunt-wound machine without compounding windings, so that the regulation is considerably wider than would be the case in a machine of modern design.

For the demonstration of the working of this little plant several recording instruments have been loaned by well-known makers.

Searchlight reflectors and silvered glass mirrors are exhibited in considerable variety. Parabolic reflectors are shown with diameters ranging from 5½ in. up to 5 ft. A split parabola ellipse reflector, so mounted that two beams can be obtained at any desired angle to one another, is also shown; this is a type specially suitable for navigation of canals and rivers by night.

A further exhibit is a patented reflector, by means of which it is possible to vary the shape of the beam produced, from a parallel beam to a spreading beam whose dimensions at a range of one mile are 1,000 ft. wide by 200 ft. high, with proportional areas at other ranges.

The Relay Automatic Telephone Co., Ltd.

(Stand No. 118, Avenue 14, Bays 11 & 12.)

The erection by this company of a 200-line private automatic telephone exchange in the Building Section, Palace of Industry, commenced on December 1st, 1923, and the exchange was completed two weeks later. This exchange provides the entire automatic internal telephone service for the Exhibition, and links up the Administration, Indian Empire, Dominions, Colonies, and many large individual exhibitors. Connections in any part of the Exhibition are made in four seconds, and the exchange gives a continuous day and night service without the aid of any human operator. The exchange is open to the inspection of visitors.

The exhibits in the Palace of Engineering consist of "Relay" public automatic exchanges, private automatic exchanges, and private automatic branch exchanges. The public exchange is of the type supplied to the General Post Office, the Government of India, the Government of South Africa, and the P.T.T., France, and is shown working with a small satellite exchange. The private automatic branch exchange is of a type similar to that manufactured and installed by the company for the Post Office in the Bank of England, Debenhams, Ltd., Babcock & Wilcock, Ltd., &c., and has multi-office working with the private automatic exchange. The private automatic exchange is a 50-line, 6-trunk model, equipped with 30 lines, embodying several of the "Relay" special service features—secretarial control, conference lines, loud-speaking telephones, &c. The "Relay" code calling system is also shown.

The "Relay" is the latest system of automatic telephony and is based on new principles. The exchanges employ no electro-mechanical switches, the exchange, as the name implies, being built up entirely with relays. All mechanical devices and moving parts (as generally understood) have been abolished, so that there are no parts to wear out, nor any need for cleaning or lubrication; all the operations of number-selection, connection, ringing and disconnection are performed by relays. Intricate as the system appears, the method of operation is exceedingly simple, and visitors, by inspecting the "Relay" exhibits in the Engineering Section, will have an opportunity of grasping some of the wonders and simplicity of the system. The "Relay" system has been adapted to the requirements of trans-Atlantic liners, and at present the company is constructing a private automatic installation for the Anglo-Persian Oil Co., Ltd., which will be the largest of its kind in England, while exchanges have been supplied to the Governments of Portugal, Brazil, Siam, &c. The accompanying illustration (fig. 50) shows the exchange in the Palace of Industry.

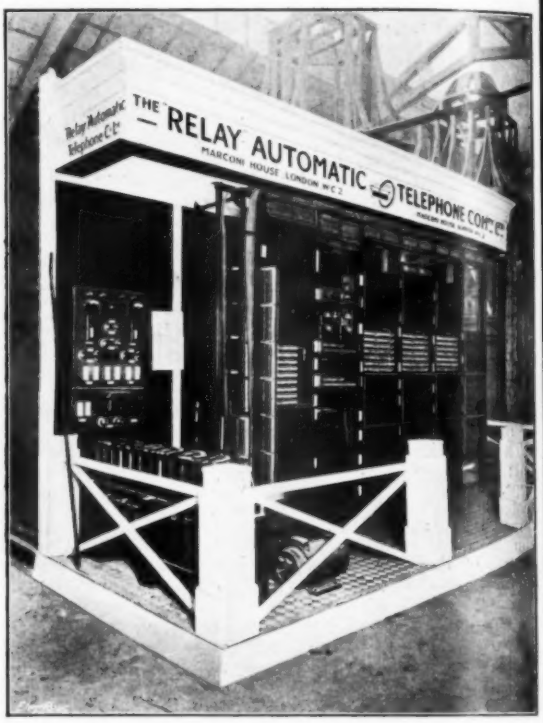


Fig. 50.—"Relay" Automatic Telephone Exchange.

Messrs. Crompton & Co., Ltd.

(Stand No. 70, Avenue 11, Bays 6 and 7.)

This company has more than 100 motors distributed throughout the Exhibition for power purposes. On their stand Messrs. Crompton are exhibiting all the standard types of a.c. and d.c. machines, control gear, instruments, and their latest type of h.p. truck cubicle; also types of a.c. and d.c. ceiling fans, and the "Suez Canal" pattern searchlight projector. A 300-kW, six-phase rotary converter, with self-contained booster, is shown in operation; this machine is designed to give the rated output at 460/520 volts d.c. for 3-wire operation, running at 1,000 r.p.m. It is illustrated in fig. 51.

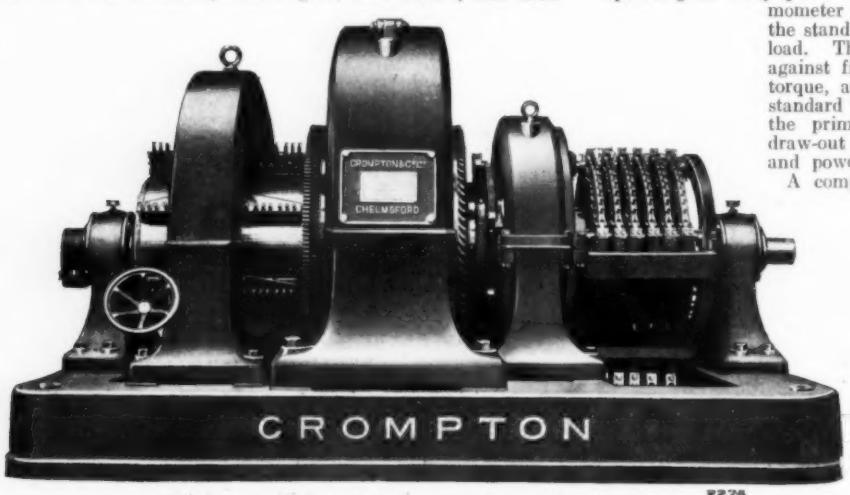


Fig. 51.—A Crompton 300-kw, Six-phase, Rotary Converter.

They also exhibit a 75-b.h.p., three-phase synchronous motor operating at unity power factor, and loaded on to a dynamometer water brake. This is operated on the stand to give up to 100 per cent. overload. The motor is designed to start against from twice to 2½ times full-load torque, and is controlled by the company's standard type of oil-immersed rotor starter, the primary side being controlled by a draw-out cubicle, with ammeter, voltmeter, and power factor meter.

A complete "Crompton" patent printing press equipment is also shown running, the main motor being designed for a continuous output of 50 b.h.p., and the inching motor intermittently rated for 10 b.h.p. The two machines are mounted on a combination bedplate. The inching motor drives through a patent type of automatic clutch. Another exhibit is a fully-automatic "Crompton-Kohler" contactor-type control panel for this equipment, the panel being designed for foolproof operation by remote push-button control, and the very wide speed range obtainable, *i.e.*, from 20 to 1,000 r.p.m., is illustrated by the use of an electrical speed indicating device. A three-phase motor generator set taking supply from the Exhibition mains supplies power to the above equipment, the motor being of

squirrel-cage construction, and controlled by Messrs. Crompton's latest type of ironclad star-delta starter with fully-automatic features.

The remaining running exhibit consists of a small 10-h.p. d.c. motor, with a "Collins" testing brake, and this is operated up to 100 per cent. overload to demonstrate the very liberal rating. Further exhibits consist of standard polyphase slip-ring and squirrel-cage induction motors and direct-current motors of the commercial ironclad and crane steelclad types.

The company also shows a board carrying 76 types of electrical instruments out of a total of 168 which it has on the market. This includes a stroboscopic vibrator for speed measurements, which is shown in use. A hand-controlled searchlight projector with automatic lamp feed is also on view, as well as battery-charging and house-lighting switchboards—both of the hand-controlled and semi-automatic type—oil-immersed liquid rotor starters, air break combined stator and rotor starters, rotor starters fitted with automatic features, and hand-controlled d.c. starting panels. A 250-kW "Crompton" d.c. generator designed for 3-wire operation and coupled to a low-speed oil engine is shown on Messrs. Ruston & Hornsby's stand, and is supplying power to the Exhibition.

Among a very large number of a.c. and d.c. machines and control gear supplied to other exhibitors is a three-phase auto-synchronous motor for driving a refrigerating compressor in the New Zealand Government building.

The Ever-Ready Co. (Great Britain), Ltd.

(*Stand No.* 114, *Avenue* 14, *Bays* 7 *and* 8.)

The stand of this company bears a large quantity of small electrical devices—principally lamps and batteries. Among the dry batteries are special designs for radio work, including large capacity l.p. batteries for use with dull-emitter valves. There are other types for all kinds of applications—bells, torches, hand-lamps, &c., as well as a range of accumulators. The lamps and lighting equipment include sets for use on bicycles, both with dry batteries and small magneto generators, hand lamps of many designs, "fountain pen" torches, electric "candles," and bulbs of all sizes. Among the other exhibits of the company are electromedical coils and electrodes, gas lighters, and fittings for automobiles, including lamps, switches, accumulators, plugs and sockets, flexibles, &c.

The Butterley Co., Ltd.

(*Stand No.* 163, *Avenue* 2, *Bays* 7 *and* 8.)

An electrically-driven coal-washing plant is shown by this company. This is capable of dealing with 50 tons of 2½-in. coal per hour. The driving motor is a 25-b.h.p. B.T.-H. machine. In addition, there are two centrifugal pumps, each of which is directly-coupled to a 10-b.h.p. motor.

Messrs. David Ashton & Co., Ltd.

(*Stand No.* 305, *Avenue* 5, *Bay* 32.)

Messrs. Ashton exhibit one of their latest type patent internal-geared, clutch-controlled mine haulage drums (fig. 52). The machine has a 5-b.h.p. flameproof squirrel-cage motor direct-coupled to self-lubricating epicyclic gears within the body of the drum. The outstanding feature of this type of machine is the patent interlock between the hand wheel of the friction clutch and the motor starter. The operator has but two controls to manipulate, namely, the clutch hand wheel and the brake lever, the latter being adjustable for hand

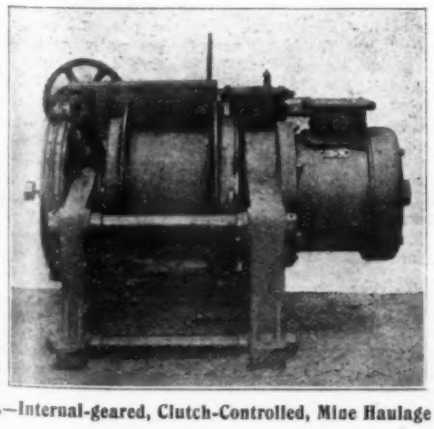


Fig. 52.—Internal-geared, Clutch-Controlled, Mine Haulage Drum.

or foot operation. Owing to the interlock the friction clutch cannot be brought into operation until the motor has been started, and the moment the circuit is closed the interlock automatically goes out of action. The load is subsequently controlled by means of the clutch, for stopping, starting, or speed regulation. The switch can only be opened when the drum is de-clutched. The firm also shows a number of photographs of other sizes and types of its internal-geared haulers which, can be driven by electricity, steam, compressed air, or oil.

Messrs. Williams & James.

(*Shipbuilding, &c., Section, Stand No.* 128, *Avenue* 3, *Bay* 28.)

This firm's principal exhibit is a 1.2 kW generating set. The engine, of 350 c.c. capacity, runs on a patented and improved two-stroke cycle, and the number of working parts have been reduced to a minimum. In the ordinary three-port type of two-cycle engine the elimination of sleeves, valves, and tappets is generally accompanied by an increase in fuel consumption and defective lubrication resulting from crank-case compression. The "W. & J." engine combines four-cycle economy and efficiency with two-stroke simplicity without the addition of valves or other working parts.

The standard plant illustrated in fig. 53 is rated at 1.2 kW, with an overload capacity of 15 per cent. The engine will run equally well on petrol, benzol, or paraffin, the fuel con-

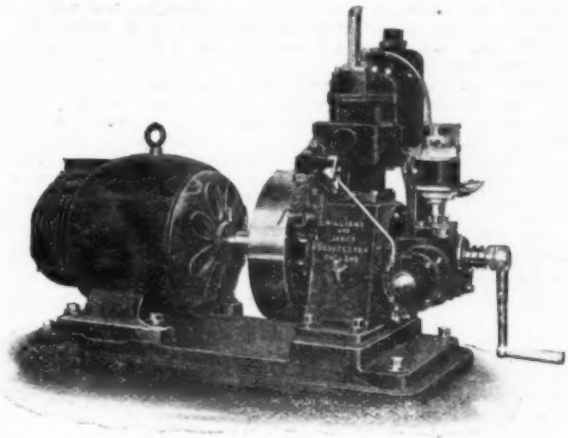


Fig. 53.—A 1·2-kW Generating Set.

sumption being approximately .9 pint per b.h.p.-hour. In the plant shown the engine is direct-coupled to the generator, but a belt drive can be provided if required.

The engine develops 3 h.p. at 1,600 r.p.m. Lubrication is effected by an oil pump, which is driven from the crankshaft through hardened and ground helical gears. The governor is of the centrifugal type, fully enclosed, and driven by helical gears. The carburetter is of the Claudel-Hobson or other approved British type. Ignition is effected by a h.p. magneto, driven by helical gearing, and mounted vertically, making it very accessible for inspection and adjustment of the contact breaker. The gears are all case-hardened and totally enclosed in an oil-tight casing cast integrally with the end bearing cover. The generator is of the ball-bearing type of Messrs. Higgs Bros'. manufacture, mounted on a substantial cast-iron bed-plate, and driven through a flexible coupling.

Messrs. Thomas de la Rue & Co., Ltd.

(*Stand No.* 91, *Avenue* 13, *Bays* 7 *and* 8.)

Messrs. de la Rue are exhibiting a complete range of telegraph and telephone line insulators, together with the necessary ironwork, pins, shackle straps, &c., for pole mounting. In connection with these there is a telegraph pole equipped with "Telenduron" line insulators, wired in accordance with standard practice. A large collection of general mouldings for the electrical and radio industries is also on view. An interesting exhibit is a complete radial commutator, 4 ft. 9 in. in diameter, with 432 copper bars moulded in position. Rotary insulating hubs weighing as much as 90 lb. are also shown.

Messrs. Drysdale & Co., Ltd.

(*Stand No.* 44, *Avenues* 5 *and* 6, *Bays* 13-15.)

This company has a display of pumps for a number of purposes. One of the principal exhibits is a 4-in. "Centrex" pump of the vertical-spindle type, which is electrically driven. It is chiefly for use on board ship, in applications for which an ordinary centrifugal pump is not suitable, on account of priming difficulties, such as bilging, ballasting, fresh-water pumping, &c. The pump first separates the air from the water by means of a properly-designed air pump, the water being handled by a centrifugal pump. A "Pervac" pump for condensate extraction in high-vacuum condensing plant is shown. The pump is of the vertical-spindle two-stage type, the motor being mounted on an extension of the main casting. The pump is designed to meet the special conditions presented, *i.e.*, air coming through the suction is promptly got rid of; air cannot get in anywhere else; the suction branch is low; the operation is stable under all conditions of load; and there is high effieciency and perfect alignment. Among other electrically-driven pumps are a 36-in. twin parallel dock pump coupled to an a.c. open-protected type of motor; a 10-in. dock leakage pump; and a 6-in. six-stage high lift turbine pump. There are also bilge pumps, a sand dredging pump, salvage pumps, &c.

Notes.

(*Continued from page 752.*)

Educational Broadcasting.—In connection with the special transmissions arranged by the B.B.C. for the purpose of exploring the possibilities of broadcasting for educational purposes, two very successful demonstrations have been carried out at the Wheatley Street Schools, Coventry. The first occasion was on April 4th, when a lecture on music by Sir Henry Walford Davies was transmitted from the London station. The second transmission took place on April 11th, when a lecture on the "Migration of Birds," by Mr. E. K. Robinson, was broadcast.

The receiving apparatus used on both occasions was a standard Radiola II (two-valve) receiver, with a B.T.H. two-valve power amplifier. On April 4th a single B.T.H. Form C2 loud speaker was installed in one of the class-rooms, and the lecture was heard quite clearly and distinctly by a double class of 70 boys. On the second occasion three B.T.H. Form C2 loud speakers, connected in parallel, were installed in three separate class-rooms, and the lecture was given simultaneously to three double classes, totalling approximately 210 boys.

In every respect the demonstrations were thoroughly successful, and the representatives of the local education authority, who were present at the second lecture, expressed their complete satisfaction with the results obtained. The apparatus used was of the ordinary standard types, and no special accessories of any kind were employed.

The two demonstrations referred to were carried out by the British Thomson-Houston Company, Ltd., which manufactured and supplied the apparatus.

The Halifax Dispute.—At the last meeting of the National Joint Board of the Electricity Supply Industry, a letter was read from the town clerk of Halifax, in which it was stated that the Halifax Town Council had accepted the recommendation of the Electricity Committee to make application for renewed membership of the National Joint Board and District Joint Board.

This carries with it, of course, the obligation to pay the salaries and observe the conditions of service as agreed and put in force by the National Joint Board.

The matter will come formally before the Employers' Side of No. 2 (Yorkshire) District Joint Board at the next meeting.

There are still two or three members of the former staff unemployed, and it is hoped that the Halifax Committee will reinstate these men. Nothing would do more than such a step to restore good feeling and confidence between the Halifax Committee and the power-station engineers throughout the country.

A Pioneer Motor Ship.—For the past 12 years shipowners have been following the *Selandia's* operations with more than customary vigilance. She was the first large motor ship built, and to this day remains a credit to those responsible for her construction. The vessel is owned by the East Asiatic Co., Copenhagen, and is an answer to the greater part of the questions arising out of the running of motor ships. Briefly, she has completed no fewer than 28 trips, each of about 22,000 miles, regularly operating between European ports and the East.

The auxiliary Diesel engines driving the compressors are coupled to electricity generators. The dynamos are 710-ampere machines working at 220 volts used for power only, the lighting system being on a 110-volt circuit, and a couple of motor generators afford the necessary reduction. Among the auxiliary plant is a pair of triple-plunger pumps for bilges and sanitary purposes, and for the supply of warm water to the accommodation, two saltwater circulating pumps for the engines, and two forced lubricating oil pumps.

For refrigerating purposes a CO_2 plant, which is electrically operated, is installed.

On deck are 12 electric winches, which have given satisfactory service throughout the whole period of their operation; we believe that they are considered less speedy in general working than modern plant of this description, but the main point is that they are reliable, and if satisfactory electric machinery of this description could be built 12 years ago it is obviously true that at the present time electric winches have reached a high pitch of excellence in design, and therefore more advantage might well be taken of their facilities. One electrician is carried for attending to the complete electrical outfit—which is all the more extensive owing to the passenger accommodation, with its corresponding demands on the supply of current. Of the 12 winches, 10 are designed for a 3-ton lift, the remaining two being smaller and intended for about 1½ tons apiece. The larger winches have 40-h.p. motors for driving, while the smaller are coupled to 25-h.p. machines. The steering gear is of the Hastie type with Hele-Shaw mechanism, an 18-h.p. motor being fitted; McTaggart Scott telemotor gear is provided, and the whole installation has proved reliable; it appears that not a single difficulty worthy of mention has arisen. An electric windlass is fitted forward, the motor being of 50 h.p.—*The Motor Ship.*

The Sodion Radio Detector.—The general principles of one form of sodion detector, which utilises a highly electro-positive alkali metal, such as sodium, were described by Mr. H. P. Doule in the April, 1923, *Proceedings* of the Institute of Radio Engineers. Possible objections to it, from some points of view, are the necessary care in handling it on account of its liquid anode and the need of operating it in a definite position. Another form, described in the April, 1924, issue of the same journal, utilises a solid anode, is of higher sensitiveness, and is designed for economy in the filament power required. Its underlying principles are the same as those of the other form and the S-13 tube can be operated in any position, and uses a filament current of less than ¼ ampere.

The sodion tube provides a new and accurate means of measuring the strength of weak signals and it has interesting possibilities, particularly on account of its simplicity and stability. For example, fading observations can be readily made with an extremely simple outfit requiring only an ordinary microammeter in the collector circuit.

This system can readily be elaborated by connecting several different circuits, each with its detector and micro-ammeter as described above, to the same antenna. This will allow fading observations to be taken from several different directions and distances simultaneously. Such an arrangement is perfectly practical since no interference can possibly take place between the several circuits.

The over-all results secured with this tube are at least equal in signal magnitude to those from a regenerator or from an ordinary detector with two stages of amplification, and this without unstable adjustments, distortion, or the possibility of interference with other receiving stations. This latter point is a factor of no little importance, particularly with the rapidly increasing congestion of receivers. The tube has also a broad field in connection with radio frequency amplifying systems either with or without regeneration.

Many other uses of the sodion tube are being investigated, and it is evident that the new device will be of utility not only as a radio receiver but as a laboratory metrical instrument. Its operation is the result of ionisation of sodium vapour, consequent dissipation of the space charge and the increased current to the "collector" electrode secured thereby. A condition of equilibrium is obtained and is broken up by an impressed signal. On account of the inherent and controllable time element a gradual decrease in anode current for a series of input impulses is secured, resulting in a large alteration of current for impulses of low amplitude and consequently a strong response for weak signals.

Electro-Farming.—At the invitation of the Gloucester Chamber of Agriculture, Mr. R. Borlase Matthews, Wh.Ex., M.I.E.E., &c., lectured there upon this subject last week. It is a matter in which farmers are taking more and more interest. The lecturer mentioned that now over 400 British farms had got electrical equipment. A description was given—for the first time in public—of the exhibit that the lecturer had arranged for the British Electrical Development Association at Wembley. Lord Bledisloe, in proposing a vote of thanks to the lecturer, strongly advised the audience that when they "wembled" to Wembley, they should first visit this exhibit, before they were distracted by other things. The lecturer's method of making hay without sunshine aroused a very interesting discussion, for if electrical methods are going to enable the farmer to circumvent the clerk of the weather, he is going to get a supply of electricity somehow. Judging from the eager questions at this and other lectures upon electro-farming applications, given before farmers, the farmer is quite ready to extend a welcoming hand to electricity, but he is apt to look upon it as a luxury beyond his reach. Evidently a great deal of educational work is still needed among farmers, to enable them to realise how advantageous a supply of electricity would be to them in their daily work. Among other facts which were pointed out at this lecture, were the possibilities of making poultry pay better, by the use of electrically heated, electric fan ventilated incubators (in which live chicks can be taken out every day, and fresh eggs put in every day—reducing incubation to a factory-like operation); by the use of electric brooders or foster-mothers; by the use of electric lighting to get 20 per cent. more eggs in winter-time; and by the use of electric motors in preparing food. Another item of interest was the indirect advantage of electric lighting in cowstalls, in that one-third less time is required to feed cattle when electric light is available, than when only hurricane lamps are obtainable.

Reference was made to an entirely new application of electricity by Mr. Borlase Matthews on his farm. This consisted in installing a number of beehives in one apiary or bee-house, and then supplying electric light and heat during the winter months, together with a little artificial feeding. This results in strong broods of bees being available, directly the fruit trees blossom. Thus a great deal of honey, which is usually unobtainable for lack of bees, is gathered in, greatly increasing the output of each hive per annum.

Educational.—POLYTECHNIC, REGENT STREET, W.—Special courses of six lectures will be given during the summer term as follows: On Monday, on "Alternating Current Wave Forms," by Mr. P. Kemp; on Tuesdays, on "The Operation of Transformers in Power Stations," by Mr. H. P. Young; on Wednesdays, on "Electric Lighting and Illumination," by Mr. W. H. Date; and on Thursdays, on "The Economics of Electrical Consumption," by Mr. D. J. Bolton. The first lecture will be given on May 19th. Fee for each course, 7s. 6d. Syllabuses on application to Mr. T. Worswick, director of education.

Finsbury Technical College.—The London County Council has addressed the following letter to the Council of the City and Guilds of London Institute:—

"With reference to my letter of the 18th ultimo, I am to state that the question of the continuance of the financial grant in aid of the above-named college after July 31st, 1926, has now been submitted to the Council. In this connection I am to refer to the Council's letter of February 5th, 1921, notifying the decision of the Council to make a grant of £10,000 a year in aid of the maintenance of the college for the quinquennial period ending July 31st, 1926, the future objective of the college to be fully considered in the interval; and to your letter of September 28th last stating that the delegacy of the Finsbury Technical College were anxious to ascertain the views of the Council as to the continuance of the college.

"Although desirous of giving the most sympathetic consideration to the claims of the college for financial aid, the Council feels that it is difficult to justify the comparatively large expenditure which at present falls on public funds in connection with the maintenance of the college, in view of the fact that there are a number of other institutions making provision for training in engineering and chemistry which could absorb, without difficulty, the number of students now attending the Finsbury Technical College.

"The Council has been informed that a conference was held between representatives of the delegacy of the Finsbury Technical College and representatives of the appropriate committee of the Council to examine the possibilities for the continuance of the Council's aid to the college, but that it was not found possible to put forward any alternative proposal with this end in view.

"After full consideration of all the circumstances the Council has reluctantly come to the conclusion that the Council is not justified in continuing its financial support to the college after July, 1926. I am accordingly now directed to inform you that the Council regrets that it will be unable to continue its grants in aid of the maintenance of the above-named institution after the expiration of the quinquennial period ending July 31st, 1926."

The letter is signed by Mr. G. F. Gater, education officer to the L.C.C.

Under these circumstances we are informed by the secretary to the Institute that there is no other course open to the Council of the Institute but to make arrangements to close down Finsbury Technical College in July, 1926, or possibly before that date. We recently drew attention to the threat that was being held over the College, whose friends must now bestir themselves if the danger is to be averted.

Local Societies.—WORKS VISIT.—On the invitation of Mr. C. A. Atchley, director of the British Electrical Plant Co., members of the Association of Mining Electrical Engineers (Lothian Branch), paid a visit to the works of the company at Alloa. The visitors inspected the latest improvements and additions to plant, as well as the new electrical and mechanical work being carried out in the various departments. The following officials have been elected by the branch:—President: J. Finlay, M.I.M.E.; vice-presidents: E. Cunningham, A.M.I.E.E., and E. Morrison; hon. treasurer: John Adam, M.I.M., and hon. secretary: James Walker.

MINING TRANSFORMERS.—A meeting of the Midland Branch of the Association of Mining Electrical Engineers was held at Nottingham on April 28th, Mr. R. Wilson in the chair. Mr. S. Austen Stigant read an interesting paper on "Mining Type Transformers," both for surface and underground use. It was illustrated with lantern slides and was followed by discussion which was contributed to by Mr. T. Green and Mr. Routledge.

The Repair of Worn Components by Electro-Deposition.—The electro-deposition method of making up worn parts of machinery only came into general use during the war. Since that time a good deal of experimental work has been carried out to determine the best method of procedure, and a paper recently communicated to the Faraday Society by Capt. J. P. McLare, of the Royal Army Ordnance Corps, usefully summarises present practice. During the war copper was chiefly employed to make up wear, on account of the ease with which thick deposits can be obtained, but this metal is obviously unsuitable for many purposes, and the problem was to determine the best conditions for obtaining thick, sound deposits of iron and nickel. It was soon discovered that the first condition for an adherent deposit was scrupulous cleanliness—in the electrochemical sense—of the article under treatment. In the paper before us a scheme of some eight operations is recommended in the case of parts which are oily, greasy or rusty. The scheme looks elaborate on paper, but it is neither difficult nor costly to put it into operation. The most important features are the electrolytic cleansing processes. No less than three such processes are recommended. The first takes place, after a preliminary removal of grease, in a boiling alkaline bath, the article to be cleaned being suspended in the bath as cathode; the second, after stopping-out parts that have not to be thickened, in a cold alkaline electrolytic bath; and the third in an acid bath, in which the article is made the anode. From this bath the article, after washing, passes to the depositing tank.

The thorough cleansing of the work ensures adherence of the deposit. To ensure a uniform, non-brittle deposit of iron and the absence of pitting due to cathodic gassing, the solution must be of a certain composition and density and a large volume of electrolyte must be employed, the object of the latter being to keep the composition of the bath constant for a long period and to obviate the necessity for any but occasional stirring. As regards the composition of the bath, a strongly-concentrated solution of ferrous-ammonium sulphate (3-3¾ lb. per gallon) was found best, and it is necessary to maintain it either neutral or else very slightly acid. The temperature should be kept uniform at about 18 deg. C. and the anodes should preferably be of soft Swedish iron, about four times the area of the work in the bath. It is interesting to note that the curious "fancy" solutions often recommended in text books and by inventors, are considered to be quite unnecessary.

The deposition of nickel, where it can be used, is preferable to that of iron because thick deposits can be obtained at fairly high current densities with far less trouble, in consequence of the absence of the formation of oxides. The bath recommended consists of nickel sulphate (2 lb.), nickel chloride (3¼ oz.), and boric acid (4¾ oz.), dissolved in a gallon of distilled water.

Among the articles which have been satisfactorily repaired by this method are worn axles of railway cranes, planing machine blocks, wagon axles, gudgeon pins, tappet valves, &c., in all cases with satisfactory results. The deposits can be case-hardened if desired. The usefulness of the method deserves to be more widely known; its extended application will undoubtedly save many a useful part from being prematurely scrapped.

Experiments have also been made with a view to evolving a resilient metallic packing to replace the textile packings at present used in the glands and stuffing boxes of buffers and recuperators of gun and howitzer mountings. The idea was to deposit lead—sometimes silver-plated—in rubber rings and thus form a resilient packing to form a tight joint and yet possess a metallic bearing surface having no corrosive effect, such as is the case with the textile packings. The experiments were promising and they are being continued, but the process is not yet entirely successful as the metallic coatings are found to split under pressure.

The Anode Effect in the Electrolysis of Fused Chlorides.—It has long been known that under certain conditions the current through a cell of fused chlorides will suddenly drop almost, if not quite, to zero, and at the same time gas evolution at the anode ceases. In this state the anode has the appearance of being "unwet," and it has therefore been suggested that the effect arises only when the anode current density is so high that liberal evolution of gas causes an insulating cushion to appear between the anode and the molten electrolyte. If this is the correct explanation there should be, for any given electrolyte at any particular temperature, a limiting maximum current density above which the anode effect appears, but below which normal electrolysis is possible. At the meeting of the Faraday Society, held on April 14th, Messrs. T. A. HEPPENSTALL and W. J. SHUTT described an experimental investigation carried out by them at Liverpool University on the conditions governing the appearance of the anode effect. For the details of the work reference must be made to the original paper. It was found that in the cases of potassium chloride, zinc chloride, and, to a less extent, lead chloride, the effect was a perfectly definite one reproducible, for the particular apparatus and arrangement employed, under well-defined conditions of temperature and current-density. In the cases studied, the higher the temperature, the lower was the limiting current-density attained previous to the appearance of the anode effect. In the case of fused sodium chloride, no definite results were obtained due, apparently, to the dispersal in the electrolyte of clouds of finely-divided metallic sodium or sodium alloy by reaction with the cathode. The work so far has been of a preliminary character, as the experimental difficulties are considerable.

National Register of Electrical Installation Contractors.—Applications for certificates of registration of all electrical installation contractors wishing to appear in the first list of the National Register, which is to be published in June, should be sent to the secretary at the offices, 1, Lincoln's Inn Fields, W.C., by May 20th. (See our advertisement columns to-day.)

Mining and Metallurgical Congress at Wembley.—We have received a copy of the programme of arrangements that have been made for the Empire Mining and Metallurgical Congress that is to be held at the British Empire Exhibition from June 3rd to 6th. A large number of papers will be read in four sections:—Mining; Petroleum; Metallurgy of Iron and Steel; and Non-ferrous Metallurgy. The researches on safety problems in mining include one on "Electricity in Coal Mines," by Robert Nelson, and one by Dr. R. V. Wheeler on "Miners' Safety Lamps." Mr. Sam Mavor will read a paper on "Mechanical Problems in Coal-getting." In one of the sections Sir Robert Hadfield is down for a paper on "Fuel Economy in Iron and Steel Works," and in another Dr. W. Rosenhain for one on "Aluminium and Light Alloys." Messrs. C. McDermid and G. C. Lloyd are the general secretaries of the Congress (225, City Road, London, E.C.). A presidential address by Viscount Long of Wraxall on the morning of the opening day will deal with "Mineral Resources, and their relation to the prosperity and development of the Empire." The mineral and coal-mining industry exhibits, also the underground workings and equipment of the model colliery, will be visited by the members of the Congress, and there will be various receptions, an official banquet, &c. Bush House, Aldwych, will be the temporary Congress office address.

Appointments Vacant.—Assistant mains engineer ($400 per month, dollar=2s. 4d.) for the George Town, Penang, Municipal Electricity Supply and Tramways Department. Boiler house superintendent for the County Borough of Wolverhampton Electrical Engineer's Department. Mechanician (£400) for the Government of the Gold Coast Posts and Telegraph Department. Sub-station attendant for the Lancaster Corporation Electricity Department. Power station superintendent for the Preston Corporation Electricity Department. Working assistant engineer (£200 +) for the Knowle Mental Hospital. (See our advertisement pages to-day.)

Institution Notes.

Institution of Electrical Engineers.—Mersey and North Wales (Liverpool) Centre.—The annual general meeting was held on April 28th at Liverpool, when the following offices were elected for the 1924-25 session:—Chairman: Mr. H. H. Harrison; vice-chairmen: Messrs. A. E. Malpas and P. J. Robinson; hon. secretary and treasurer: Mr. O. C. Waygood; and ordinary members of the Committee: Messrs. A. G. Barnard, E. L. Morland, A. S. Wilson, and Prof. E. W. Marchant.

Scottish Centre.—The final meeting for this session of the Scottish Centre of the Institution took place on Friday, April 25th. This meeting was held, as is now the custom, at Dundee, the arrangements being made by the Committee of the Dundee Sub-Centre. Shortly after the arrival of the party from Glasgow, lunch was served in the Royal Hotel, Dundee. Following on this, the party was taken by motor to Belmont Castle, which is some 15 miles from the city, and was given by Mrs. Marryat to the Corporation of Dundee. Having inspected the house and grounds, the members were entertained to tea as guests of the Corporation. The party having returned to Dundee, dinner was served in the Royal Hotel, after which the members assembled at University College. A paper was then read by Dr. R. D. Archibald, the subject being "The Characteristics of a d.c. Series Motor self-excited by Rectified Current for purposes of Regenerative Control." Dr. Archibald was one of the founders, and is also an ex-chairman, of the Dundee Sub-Centre. An interesting discussion followed, in which many members took part, a notable contributor being Dr. S. P. Smith. It was generally agreed that a most enjoyable day had been spent, and the Committee of the Dundee Sub-Centre—in particular Mr. W. Frain, the hon. secretary, who was chiefly responsible for the arrangements—is to be congratulated on an excellent meeting to conclude the session.

Junior Institution of Engineers.—On April 25th Mr. H. G. Williams delivered a lecturette on "Aluminium Electrical Conductors for Overhead Power Transmission." Mr. Williams treated the subject very fully, dealing with financial considerations as well as with details of construction and the efficiency of aluminium transmission lines. He said that the ratio of cross-sectional area of copper to its equivalent in aluminium in respect of conductivity was about 100 to 159. Since the weight of aluminium was about one-third that of copper, an aluminium conductor having an area 59 per cent. greater than that of copper, and therefore the same electrical conductivity, would weigh about half as much as a copper conductor. Aluminium showed a distinct saving in first cost of material, and, by virtue of its lightness, the load upon structures was much less than that imposed by copper. The saving was more marked when high pressures were used over long distances, and particularly over mountainous country. The use of aluminium conductors allowed longer spans.

Cables consisting of steel core round which aluminium was stranded had now been tried in service in such a variety of localities and under such varying conditions, that their reliability and efficiency had been demonstrated. It was important that the steel wire should be galvanised to prevent electrolytic action and corrosion of the steel. As regards the effect of the weather and the atmosphere on aluminium conductors, hydrochloric acid or strong caustic soda vapours would dissolve the metal, and if aluminium cables were brought into contact with copper or brass wires or clamps in the presence of moisture, there would be electrolytic action. Galvanised iron or aluminium fittings had therefore to be used. There were many cases in which aluminium cables had been in service for many years on the sea coast, on steam railways, and near coke ovens, without any deterioration. Troubles were often traced to impurities in the metal.

Institution of Civil Engineers.—Forrest Lecture.—Prof. Elihu Thomson, of Massachusetts, U.S.A., has accepted an invitation to deliver the 30th James Forrest Lecture during a visit to this country, and accordingly the lecture, which was originally fixed for May 6th, has been postponed until July 8th. Prof. Thomson has been awarded, by the presidents of the eight British engineering institutions, constituting the Award Committee, the triennial Kelvin Gold Medal, for 1923; and formal presentation of the medal to him will take place during the Kelvin centenary celebration in July.

Institution of Automobile Engineers.—Coil *v.* Magneto Ignition.—The Institution of Automobile Engineers organised an informal discussion on the subject of coil *v.* magneto ignition for motor cars at the Society of Arts on Tuesday, April 29th.

Institute of Transport.—The fourth annual congress will be held at Bristol from May 29th to 31st. On the first two days the mornings will be devoted to the reading and discussion of papers, the afternoons and the whole of the third day being spent in visits and inspections. The Lord Mayor of Bristol, and the Mayors of Bath and Gloucester, will receive the visitors, and there will be various social functions. Papers will be read on "The Port of Bristol," "The problem of road surfaces with regard to mechanical transport," "Freight train formations," and "The next five years of aerial transport." Amongst the places visited will be the Avonmouth Docks, the city of Bath, the works of the Great Western Railway at Swindon, and the Severn canals to Worcester.

The Royal Institution.—The annual meeting was held on May 1st, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The annual report of the Committee of Visitors for the year 1923, testifying to the continued prosperity and efficient management of the Institution, and the report of the Davy-Faraday Research Laboratory Committee, were read. Fifty-three new members were elected during the year, and 63 lectures and 18 evening discourses were delivered. A total of 634 volumes was added to the library in the year. Thanks were voted to the president, treasurer and secretary, to the Committees of Managers and Visitors, and to the Professors for their valuable services to the Institution during the past year. The following gentlemen were unanimously elected as officers for the ensuing year:—President, the Duke of Northumberland; treasurer, Sir James Crichton-Browne; secretary, Sir Arthur Keith.

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The Metropolitan Asylums Board Works Committee recommends that the salary of Mr. J. W. Fyfe, assistant engineer, be increased from £360 to £380 per annum; that the salary of Mr. L. J. J. Murfin, first assistant engineer, be increased from £660 to £720, by two increments, and that he be awarded the first increment of £30 per annum forthwith; and that the salary of Mr. T. Cooper, engineer-in-chief, be increased by £100 per annum.

The *Electrical News* (Toronto) states that Mr. H. H. Couzens has resigned the position of general manager of the Toronto Transportation Commission and the Toronto Hydro-electric System to become vice-president in charge of the affairs in Brazil of the group of public utilities controlled by the Brazilian Traction, Light & Power Co. Mr. Couzens is succeeded by Mr. E. M. Ashworth as general manager of the hydro-electric system, and by Mr. D. W. Harvey, who takes over the management of the transportation system. Both gentlemen were assistant managers, Mr. Ashworth having acted as general manager of his branch for some time past.

Mr. Bernard Howard, for 27 years with Messrs. W. A. Shaw & Co., electrical engineers, Stockport, who has left to go into business for himself at Hazel Grove, has been presented by the firm with a gold watch in recognition of his services as foreman.

The staff of the Sheffield branch of the British Thomson-Houston Co., Ltd., last week entertained Mr. Alfred Lucas, the manager, on his completion of a quarter of a century's service with the company, and presented him with a spirit tantalus.

Mr. W. C. Bexon, the engineer and manager of the Kilmarnock Corporation Electricity Supply Department, has been appointed engineer and manager of the Ayrshire Electricity Board, which has taken over the Kilmarnock and Ayr electricity undertakings.

Last week, at Bispham, Mr. Douglas Moore, B.Sc., a chemist at the works of the United Alkali Co., was married to Miss Bessie Robertson, daughter of Mr. J. A. Robertson, the well-known electrical engineer. The parties first met when both were students at the Manchester University.

Mr. R. A. Lower, of Norwich, has been appointed chief sales engineer to the Yorkshire Electric Power Co., and will take up the appointment on June 2nd; his office will be situated at 36, Park Place, Leeds. Mr. Lower has been sales engineer to the Norwich Corporation Electricity Works since 1911.

Mr. T. H. U. Aldridge, engineer-in-chief and manager of the Shanghai municipal electricity department, is due to arrive in England in the first week in June.

Mr. John Ferguson, chief engineer of Glasgow Corporation Tramways Department, has resigned, and the committee is to record in its minutes high appreciation of the very able and valuable service he has rendered to the Corporation during the 26½ years he has been a member of the staff of the Tramways Department. Mr. G. G. Braid, deputy chief engineer, will succeed Mr. Ferguson.

Mr. F. G. KETELBEY, A.M.I.E.E., who for 12½ years was connected with the British Thomson-Houston Co., Rugby and Birmingham, has now relinquished his position as Midland branch manager of the Electrical Apparatus Co., Ltd., and opened offices at Worcester Chambers, 14, New Street, Birmingham, where he will be trading in his own name as chartered electrical engineer and mechanical engineer.

A Melbourne paper states that Prof. Sir DAVID ORME MASSON and Mr. H. W. GEPP, general manager of the Electrolytic Zinc Company of Australasia, Ltd., were leaving for England on March 22nd.

We are glad to state that Mr. PERCY E. RYCROFT, M.B.E., M.I.E.E., has now fully recovered from his recent severe illness—double pneumonia followed by an operation for empyema—and has rejoined his company, Messrs. Babcock & Wilcox, after being absent from his office since January last.

Mr. C. S. WALKER, a member of the engineering staff of the Bath Corporation electricity department, has been appointed station superintendent there.

Obituary.—MR. H. M. BYLLESBY.—A Central News dispatch from Chicago to the *Daily Telegraph* reports that Mr. Henry Marison Byllesby, the well-known electrical engineer, died on Friday last, in his 76th year. "Mr. Byllesby was associated with Thomas Edison in the early days of electric lighting in New Jersey, and had been identified with many movements and advances in electrical enterprises in the States. He was president of the Chicago engineering firm bearing his name, and a director of numerous other companies."

MR. S. R. WHYTE.—The death is announced, at the age of 51 years, of Mr. Sydney Ross Whyte, electrical engineer, of 246, London Road, Croydon, who was a member of the Electrical Contractors' Association.

MAJOR S. UTTING.—We regret to announce the death of Major Samuel Utting, M.I.Mech.E., A.M.Inst.C.E., from pneumonia.

New Companies Registered.

Ward Services, Ltd. (197,543).—Private company. Registered April 25th. Capital, £100 in £1 shares. To adopt two agreements, the parties to which are not named, and to carry on the business of manufacturers and distributors of and dealers in electric signs and intermittent flash signs, electric projectors, coloured light and multi-chrome signs, transparent and electrically lighted paintings and designs, art illuminations, artistic publicity and advertising signs and devices, pictorial and graphic, electrical and mechanical displays, &c. The subscribers (each with one share) are:—G. W. Colquhoun, 69, Charrington Street, N.W.1, electrical sign manufacturer; G. H. Olley, 11, Queen Victoria Street, E.C., solicitor. The first directors are to be appointed by the subscribers. Qualification, one share. Remuneration, 100 guineas each per annum. Solicitor: G. H. Olley, 11, Queen Victoria Street, E.C. Registered office: 216, Edgware Road, W.1.

Erith Electrical Co., Ltd. (197,485).—Private company. Registered April 25th. Capital, £2,000 in 1,800 ordinary shares of £1 and 4,000 deferred shares of 1s. To acquire the business carried on by W. J. Barber, at Erith, and to carry on the business of electricians, electrical or mechanical engineers or contractors, suppliers of electricity for light, heat, motive power, wireless communication, &c. The first directors are:—G. H. Martin, Brynafon, New Road, Abbey Wood, S.E.2, timber merchant (chairman); W. J. Barber, 5, Barnehurst Avenue, North Heath, Erith, electrical engineer (managing director). Solicitors: Habershon, Watts & Co., 29 and 30, Greens End, Woolwich, S.E.18.

Roddis Electric, Ltd. (197,575).—Private company. Registered April 19th. Capital, £2,200 in 2,000 5 per cent. non-cumulative preference shares of £1 each and 4,000 ordinary shares of 1s. each. To adopt an agreement with C. H. Roddis for the purpose of acquiring an invention relating to wireless circuits and all improvements upon and additions thereto. The first directors are:—J. J. Lemarque, St. Eloi, Luton Avenue, Broadstairs; W. Wrentmore, 202, Old Road West, Gravesend; C. H. Roddis, 59, Sisters Avenue, Clapham Common, S.W.11; C. K. Gratton, 52, Alleyn Road, Dulwich, S.E.21. The three first named are permanent. Solicitors: Warwick and Gilbert, 14, Queen Victoria Street, E.C.4. Registered office: 14, Queen Victoria Street, E.C.4.

S. W. Radio, Ltd. (197,494).—Private company. Registered April 25th. Capital, £100 in £1 shares. To carry on the business of importers, exporters, general merchants and dealers, commission agents, manufacturers of and dealers in wireless or electrical fittings, &c. The first directors are:—C. B. Stokes, Villa Moszowicki, Avenue Comba, Boulevard Gambetta, Nice, France (director of Williams Stokes Wireless Co., Ltd.); W. Williams, 77, Muncaster Road, S.W.11 (director of Williams Stokes Wireless Co., Ltd.). Secretary: F. F. Cliveley. Solicitors:—Sturton and Sturton, 74, Great Tower Street, E.C.3. Registered office: 6, Broad Street Place, E.C.2.

Basson Electrical Co., Ltd. (197,565).—Private company. Registered April 29th. Capital, £500 in £1 shares (100 5 per cent. cumulative preference and 400 ordinary). To carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, sound and power, manufacturers of and dealers in all apparatus used in connection with electrical and wireless installations and wireless sets and accessories, &c. The permanent directors are:—E. L. Castle, Holly Mount, Station Road, Pendlebury, electrical engineer; H. Basson (manager), 24, Bingham Street, Swinton, electrical engineer. Qualification, £25. Remuneration: £5 per annum, divided between them. Solicitor: John Knight, Manchester. Registered office: 32, Station Road, Swinton, Lancs.

Whitecroft Instrument Co., Ltd. (197,498).—Private company. Registered April 25th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of and dealers in all kinds of instruments, apparatus and appliances for the reception or transmission of wireless telephony and wireless telegraphy, &c. The first directors are:—A. J. Watts, Highfield, Lydney, Glos.; W. K. Coxon, Nurschill, Lydney, Glos.; M. Jarrett, Elmsleigh, Grove Road, Lydney, Glos.; S. Jarrett, Foxhill, Lydney, Glos. Secretary: S. Jarrett. Solicitor: H. H. Vowles, 65, Northgate Street, Gloucester. Registered office: The Pin Works, Whitecroft, near Lydney, Glos.

Charles I. Hughes & Co., Ltd. (197,545).—Private company. Registered April 28th. Capital, £750 in £1 shares (350 4 per cent. cumulative preference and 400 ordinary). To acquire the business of an electrician and electrical engineer and contractor now carried on by Chas. I. Hughes at Waterloo, Lancs., as "Charles I. Hughes." The first directors are:—C. I. Hughes (permanent), 12, South Road, Waterloo (manager); C. Hughes, 12, South Road, Waterloo. Qualification, £50. Solicitor: E. G. C. Wright, 37, Moorfields, Liverpool. Registered office: 37, Moorfields, Liverpool.

Official Returns of Electrical Companies.

Bray, Markham & Reiss, Ltd.—Satisfaction in full on October 14th, 1922, of debentures dated March 24th, 1920, securing £8,000. (Notice filed April 14th, 1924.)

Wholesale Electrical Co. (1922), Ltd.—L. R. Stevens, of 5, Guildhall Chambers, Basinghall Street, E.C., was appointed receiver and manager on April 14th under powers contained in first mortgage debentures dated January 14th, 1924.

Henry Joseph & Co., Ltd.—Particulars filed of £5,000 debentures authorised April 7th, 1924, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £2,700.

Childs' Electrical Stores, Ltd.—Debenture dated April 14th, 1924, to secure £462 10s. charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. C. A. Childs, 72, Lancaster Road, North Kensington, W.

Accumulator Charging Co., Ltd.—Debenture dated April 16th, 1924, to secure £75 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Milner Bros., Ltd., Abbey House, Victoria Street, S.W.

West Central Manufacturing Co., Ltd.—F. T. Shearcroft, of 76, Newgate Street, E.C.1, was appointed receiver and manager on April 22nd, 1924, under powers contained in first mortgage debenture dated October 8th, 1923.

Brown & Whitehead, Ltd.—W. H. Bell, of 3, Bridge Road, Woolston, Southampton, was appointed receiver on April 10th, 1924, under powers contained in debenture dated May 14th, 1923.

Lamp Manufacturing Co., Ltd. (76,151).—Return dated February 21st, 1924. Capital, £10,000 in £1 shares. 5,400 shares taken up. £5,400 paid. Mortgages and charges, £2,500 debentures.

Vactite Wire Co. (1919), Ltd. (156,012).—Return dated December 13th, 1923. Capital, £25,000 in £1 shares. 15,000 shares taken up. £3 paid. £14,997 considered as paid. Mortgages and charges, nil.

Robert W. Blackwell & Co., Ltd. (63,446).—Return dated January 14th, 1924. Capital, £50,000 in £1 shares. All shares taken up. £18,338 paid. £31,662 considered as paid. Mortgages and charges, nil.

Macintosh Cable Co., Ltd. (72,097).—Return dated October 30th, 1923. Capital, £100,000 in 75,000 ordinary and 25,000 preference shares of £1 each. 51,008 ordinary and 23,997 preference shares taken up. £13,004 paid. £62,001 considered as paid. Mortgages and charges, £6,500.

Scott Brothers (Halifax), Ltd.—Deposit on April 14th, 1924, of deeds of certain property in Halifax, to secure all moneys due or to become due from the company to Lloyd's Bank, Ltd., not exceeding £6,000.

City Notes.

English Electric Co., Ltd.

The ordinary general meeting was held on Wednesday last week at the Connaught Rooms, Great Queen Street, Sir Charles E. Ellis, G.B.E., K.C.B., in the chair. In moving the adoption of the report, the chairman said that the net profit for the year amounted to £261,795, which, despite the admittedly difficult trading conditions of the year under review, was equal practically to that shown in the previous year. In all the circumstances that result was one on which they had every reason to congratulate themselves. The preference and ordinary share capital had been increased by £427,515. That increase was reflected in the item of interest in subsidiary and other companies on the assets side of the balance sheet. That was a satisfactory feature, particularly as debentures in one of their subsidiary companies had been redeemed out of the proceeds of that share issue. The board had thus been able to proceed further in consolidating the financial position of the company. In 1921 the board created and issued £1,250,000 8 per cent. short date notes. Taking advantage of a favourable turn in the financial market, they were able last year to refund the whole of that issue for an equal number of 6 per cent. 40-year convertible debentures. That operation had the very gratifying result of reducing their fixed debenture charges by no less than £41,449 per annum. Noteholders were offered either cash or the privilege of exchanging into the new debentures, and it was gratifying that over 70 per cent. of the original stockholders converted their holdings and thus retained their interest in the concern. On the assets side of the balance sheet the item of land, buildings, plant, machinery, &c., after bearing adequate depreciation, showed an increase of a little over £30,000 on the figure of the previous year. That was accounted for by a number of additions and improvements, carried out at their various works after careful consideration. Although the item stock and work in progress at £1,354,900 was barely £200,000 more than the equivalent figure of a year ago, that did not fully reflect the increase in business as there had been a further reduction in general stock during the year. The orders received during the year under review were much in excess of those for the previous year. An equally satisfactory feature of the order book was its geographical distribution. Contracts were obtained from all parts of the world—some of the most important from territories as yet little touched in which they might find the new markets so essential to British industry at the present time. The satisfactory progress recorded last year in connection with water-power development had been more than maintained. Over 200,000 h.p. of water-turbines, with the appropriate generating plant, were sold during the year, and they secured orders for the largest units ever manufactured in this country, both for high and low falls. For the Sorocaba station of the Sao Paulo Electric Co., in Brazil, they had recently completed

a 25,000-h.p. reaction water-turbine and the alternator to be driven by it, while for the Tata Power Co., the third of the great hydro-electric projects in the neighbourhood of Bombay to be developed under the auspices of Messrs. Tata & Sons, Ltd., they were constructing five units, each of 30,000 h.p., for a fall of over 1,100 ft. They might justifiably claim that the execution of orders such as those placed the company in the front rank amongst the world's manufacturers of water-power plant. Last year he had referred to the installation on the Midi Railway of France of the "English Electric" type of motors and control equipment. Many of the equipments now running on the Midi Railway were manufactured at .... company's Preston works, and those who had travelled on the line between Pau and Toulouse in the last few months would have appreciated how reliable and efficient was their apparatus in the field of electric traction. A very large order for electric locomotives for the Japanese Government Railways was delivered partly before and partly after the earthquake, and it was a tribute to their many friends in Japan that, in spite of the appalling disaster which overtook their country, work on the electrification of their railways had already recommenced, and the majority of the locomotives were installed and ready for operation. Work on the equipments for the electrification of the Great Indian Peninsula Railway was well on towards completion. Their largest traction contract of the year at home was that in connection with the electrification of the south-eastern section of the Southern Railway. That order, which comprised 508 motors, each of 300 h.p. and 19 1,500-kW rotary converters, was well in hand. The whole of the active productive units of the company were working full time, and the amount of work in hand promised a continuity of that happy state of affairs for some time to come. The future was by no means free from anxiety. The level of prices still remained too low, and the competition of countries with depreciated currencies and lower production costs was acting continuously as an obstacle to a really fair price being obtained. If, as they heard so continuously asserted, a permanent recovery of British trade depended upon the settlement of Europe, it was equally true that even then the pressure of competition upon their industries would be eased only by a closer approximation of the standard of life in Continental countries to that in their own. There was a tendency on the part of certain public authorities to consider any figure in excess of that asked by the lowest tenderer, whether foreign or British, to be an attempt to extort from them high and unjustifiable prices. British trade was not built up nor would it be maintained on the factor of price alone; and it was regrettable that the loyalty of the vast majority of buyers, public and private, in paying higher prices for British material should be obscured by the Press campaigns of those who had placed work abroad and were noisily endeavouring to justify their action. To reduce the cost of production, sacrifices had been made, and old prejudices discarded both by employers and workers in the engineering and allied industries. Their most formidable difficulty at the moment was outside their control. It lay in the striking disparity in wages between the workmen employed in their factories and those engaged in what had become known as the "sheltered" trades. Hitherto little had been done to mitigate what was at once an injustice and a paralysing economic condition. It would require all the tact and forbearance of both parties in wage negotiations if they were so to reduce their costs, by a return to earlier and more equitable relative wage standards, that they could compete freely and successfully in the world's markets. That was the immediate problem which faced those responsible for the management of the company and all the other great exporting enterprises.

Mr. W. L. Hichens, deputy chairman, seconded the motion, which was carried unanimously.

Shropshire, Worcestershire and Staffordshire Electric Power Co.

Mr. E. Garcke presided at the annual meeting on April 30th. In moving the adoption of the report and accounts (which were abstracted in our issue of April 25th, p. 669), the chairman remarked upon the further improvement which had occurred. He said that the net receipts for 1923 were £168,000, as compared with £95,000 in 1921, and the available balance of profit had increased from £41,000 in 1921 to £130,700 last year. In spite of this great improvement, the directors had thought it prudent to make only a small distribution on the ordinary shares. Anticipated expansion would make large demands upon the company's resources, and therefore a substantial sum had been placed to reserve to strengthen the position of the company. The loan from the Ministry of Munitions had been reduced by agreed instalments, and the outstanding balance was £230,000. Other loans had increased by £108,000, due to the transfer to the company of the liability to repay the loans secured upon the undertaking of the Redditch Urban District Council, which was taken over in April last year. The demand for electricity continued to increase in spite of the difficult times which trade was experiencing. The connections had risen from 61,200 kW at the end of 1922 to 69,200 kW at the end of last year; the acquisition of the Redditch undertaking accounted for half of this increase. If trade revived during the present year the Dudley, Kidderminster, and Redditch stations would be fully loaded during the winter months. The construction of the Stourport station was being expedited with a view to connecting it up with the other stations. Reductions in charges had been made during the year, but there were indications of increased costs since the beginning of the year. In addition to acquiring the Redditch undertaking, an Order had been obtained for the supply of electricity in Bromsgrove, Droitwich, and other places in North-East Worcestershire. Transmission lines were being rapidly installed.

Craigpark Electric Cable Co., Ltd.

The accounts for the year ended March, 1924, show a net profit of £9,853 (after making provision for corporation tax), which, with the balance of £1,592 brought forward, makes £11,445. From this sum there is appropriated for depreciation of buildings and machinery, £2,000; 6 per cent. preference dividend, £2,850; dividend of 12½ per cent. for the year on the ordinary shares, £4,687; leaving to carry forward, subject to directors' fees, £1,907. "There has been an increase in trade during the year, but a considerable portion of it has been at very low prices, which has had its effect on the profits. The prospects for this year are better." Meeting: Glasgow, May 15th.

Italian Electrical Companies.

Società Generale Italiana Edison di Elettricità (Milan). Capital, 180,000,000 lire.—The report of the council gave details of the progress of the company, together with that of its group of associates (Banfi, Stel, Valle Antrona, Conti, Piemonte Orientale, Dinamo, Assolana, Bresciana, &c.). The plant capacity of the group was 280,000 kW; and the total energy produced and acquired was 1,118,000,000 kWh. Among the works in progress, particular mention was made of the installation on the Ovesca and the 140,000-volt line from Pallenzeno to Brugherio and another from Pallenzeno to Arquate Scrivia. The balance from the last year's working showed a net profit of 24,119,925 lire, from which, after allotting 5 per cent. to the reserve, a dividend of 36 lire per 500-lire share was declared.

Società Elettrica ed Elettrochimica del Caffaro (Milan). Capital, 12,000,000 lire.—The ordinary general meeting passed the accounts for the year 1923, the available balance being 1,983,807 lire, from which a dividend of 15 per cent. per share was distributed.

Officine Elettroferroviarie (Milan). Capital, 12,000,000 lire.—The result of the past year's working was a profit of 4,819,343 lire, from which a dividend of 16 per cent. was approved, with the balance of 87,943 lire carried to the reserve, which now amounts to 2,400,000 lire.

Società Elettrica della Venezia Giulia (Trieste). Capital, 20,000,000 lire.—The report for the year 1923 shows that there was an available balance of 887,504 lire, from which a dividend of 4 per cent. was declared.

Imprese Elettriche Conti (Milan). Capital, 100,000,000 lire.—At the last general meeting the accounts were approved, the balance allowing of a dividend distribution of 10 per cent.

Società Brioschi per Imprese Elettriche (Milan). Capital, 30,000,000 lire.—The balance on December 31st—2,722,082 lire—allowed of a dividend of 10 per cent.

Società Anonima Elettricità Alta Italia (Turin).—The general meeting approved the accounts to December 31st, which allowed of a dividend of 20 lire per 250-lire share.

Società Idroelettrica Piemonte S. I. P. (Turin). Capital, 100,000,000 lire.—The report recently approved by the meeting of shareholders allotted a dividend of 10 lire per 125-lire share.

Terni: Società per l'Industria e l'Elettricità (Rome). Capital, 350,000,000 lire.—For the year ended December 31st there was an available profit of 13,616,460 lire, from which a dividend of 25 lire per 400 lire share was allotted, leaving 3,518,330 lire to be carried to depreciation account.

Società Lombarda per Distribuzione di Energia Elettrica (Milan). Capital, 80,000,000 lire.—The report of the council gave details of the new works undertaken by the company, among others the Brembo installation and the 130,000-volt line from Carona to Cislago, 90 km. in length. Last year's working yielded a profit balance of 7,016,705 lire, from which, after allotting 5 per cent. to the reserve, a distribution of 60 lire per 500-lire share was sanctioned.

Società Elettrica Bergamasca (Bergamo). Capital, 12,000,000 lire.—The available balance allowed of a distribution of a dividend of 9 per cent.

Società Generale Elettrica della Sicilia (Milan). Capital, 780,000,000 lire.—The working year 1923 has been marked by the starting of the installation on the upper Belice River, but this has had little influence on the general economy of the company, as the water has had to be used for the first filling of the storage dam. The sum of 6,994,601 lire resulted from the year's working, from which, after setting 5 per cent. apart for the reserve fund, a dividend of 10 per cent. was declared. An extraordinary meeting of the company has approved the raising of the company's capital from 80,000,000 to 120,000,000 lire, by the issue of 400,000 100-lire shares.

The *Società Trazione Elettrica Lombarda* (Milan) has decided to increase its capital from 10,000,000 to 12,000,000 lire by the issue of 4,000 500-lire shares.

German Electrical Companies.

The report of the Electricity Company (late Schuckert) of Nuremberg, which is in the Siemens group, refers to the growing burdens and expenses associated with the depreciation of the currency in 1923, and states that a large part of the company's activity had to be devoted to adapting itself to the constantly changing value of

money. As a consequence of the scarcity of money none of the schemes for the establishment of new electricity works by the utilisation of water powers could be carried out, and it was uncertain whether any of them would be proceeded with in the near future. At the same time it is pointed out that the devastating effects of the fall of the mark in the second half of 1923 did not affect the supply undertakings to the same serious extent as it did the manufacturing companies, as the supply of light continued to progress, particularly for domestic purposes. The report gives details of the many undertakings in which the company is interested. The net profits have been carried forward to 1924.

The *Mines Insulator Company*, of Dusseldorf, which was formed in 1923, proposes to carry forward the net profits for that year and to increase the share capital in order to meet the development of the undertaking, which is said to have a stock of orders.

The *Electricity Supply Company*, of Berlin, reporting on the situation of the undertakings in which the company is interested, states that after a temporary decline last year, a revival in the consumption of electrical energy had taken place and the number of connections had increased in the case of all the works. Some local authorities, appealing to the paper mark contracts, had denounced the agreements with a view to securing possession of the local installations, but the company had refused to deliver, although negotiations on the matters were in progress. The paper mark profits, 318,800 billions, have been brought over to 1924.

The *Mix and Genest Telephone and Telegraph Works Co.*, of Schoneberg, Berlin, reports net profits of many billions of marks in 1923, which sum has been carried forward.

The *Company for Electrotechnics and Machine Construction*, of Frankfort-on-Main, has resolved to bring forward to 1924 the net profits of 30,000,000,000 paper marks which were obtained last year.

The *Welter Electricity and Lifting Appliances Co.*, of Cologne-Zollstock, has decided to carry forward the net profits of 7,000 gold marks earned in 1923. At the recent meeting the chairman stated that the prospects were not unfavourable; the department for small lifting appliances was well occupied, and the foreign business had also improved, and good orders had been received in recent weeks for heavy lifting machinery.

Belgian Electrical Companies.

The report of the *Société de la Central Electrique de l'Entre-Sambre et Meuse*, of Liége, for last year shows a net profit of 3,530,086 fr., as compared with only 2,731,061 fr. in 1922. After making ample provision for reserve, the directors are dividing a sum of 1,950,000 fr. among the shareholders, which is equal to a dividend of 13 per cent. on the capital of 15 million fr., as against 11 per cent. in the preceding year.

The report of the *Société de la Fabrication des Cables et Fils Electriques*, of Brussels, for last year, shows a net profit of 900,000 fr., as compared with 750,000 fr. in 1922. After making ample provision for depreciation and reserve the directors are distributing 549,000 fr. among the shareholders, this being equal to a dividend of 27 9/20 per cent. on the capital of 2 million francs. In both 1922 and 1921 the dividend was equal to 22½ per cent.

The *Société des Centrales Electriques des Flandres*, of Brussels, is increasing its capital to the extent of 15 million francs and has just invited applications for 30,000 new shares of 500 fr. each, offered for subscription at 685 fr. per share

French Electrical Companies.

La Société Gramme, of Paris, reports a net profit of 552,573 fr. for last year, as compared with 534,806 fr. in 1922.

La Société Nantaise d'Eclairage et de Force Electrique, of Nantes, is declaring a dividend of 8¼ per cent. for last year, as compared with only 6 per cent. in 1922.

La Société des Exploitations Electriques, of Paris, is increasing its capital from 18 to 25 million francs by the issue of 28,000 shares of a nominal value of 250 fr. each.

North Berwick and District Electric Light and Power Co., Ltd.—At the recent annual meeting, Sir E. S. Schafer, the chairman presiding, it was stated that the directors had lodged an application with the Commissioners for a Provisional Order, and had confidence that the application would be granted. In that case they were prepared to raise the additional capital required to extend the undertaking to parts of the town which were not served by the existing mains. The company is paying a dividend of 10 per cent., and it has been able to substantially reduce the price of electricity to consumers.

Urban Electric Supply Co., Ltd.—The report for the year ended December, 1923, shows that the net profit balance, after providing for interest, debenture stock redemption and income tax, is £74,263, plus £4,599 brought forward. There is put to reserve for depreciation £30,000; to general reserve £5,000; to writing off part of the 5½ per cent. debenture stock issue expenses; 6 per cent. has been paid on the cumulative preference shares; £1,250 has been devoted to purchasing funded dividend certificates; 4 per cent. dividend for the year is recommended on the ordinary shares; and £9,872 remains to be carried forward. The proposals embodied in the scheme submitted with the last report and approved have been given effect to in the present accounts. Meeting: May 14th, in London.

Spanish Company.—The Compania Hispano-Americana de Electricidad, of Madrid, which succeeded the German Transmarine Electricity Co. in the ownship of the electricity works in Buenos Ayres and other South American towns, proposes to pay a dividend at the rate of 12 per cent. in gold for 1923, of which 5 per cent. has already been paid, as compared with 11 per cent. in paper for 1922. It is asserted that the company has acquired on favourable conditions the electrical installations of the River Plate Electricity Company in the city of La Plata.

Dublin and Lucan Electric Railway Co.—Mr. J. W. Hill, J.P., presiding at a meeting of this company, said that the loss on the year's working was nearly £1,000 less than in 1922, £2,627 in 1922 against £1,739 in 1923). Unless they could convert the loss into a profit the company could not continue. The number of passengers carried was 405,363, a decrease of 3.8 per cent. on 1922. The wages paid were out of all proportion to revenue, being 56 per cent. on the year of the entire revenue, as against 31 per cent. in 1913.

Pennsylvania Water and Power Co.—The total revenue from all sources during 1923 was $2,124,400, which was reduced to $983,524, after providing for all charges. This sum has been allocated as follows:—Four quarterly dividends, $639,250; transfer to depreciation account, $175,410; to reserve for sinking fund, $75,000; to contingent fund, $93,000; carried forward, $863. The gross revenue increased by $120,949, and the net revenue by $60,600.

Chloride Electrical Storage Co., Ltd.—Manchester dispatches to the financial Press state that the directors announce a final dividend of 5 per cent., together with a bonus of 2s. per share, both free of tax, on the ordinary shares, making a total for the year to March 31st last of 30 per cent., against a total of 15 per cent., free of tax, for the previous year.

Chile.—In the report of the Compania Hispano-Americana de Electricidad for last year, it is announced that it has disposed of its undertakings in Chile—the Chilian Electric Tramways and Light Co., Ltd., of Santiago, and the Compania de Tranvias Electricos, of Valparaiso—to an English syndicate on advantageous terms.

Chinese Company.—La Compagnie Française de Tramways et d'Eclairage Electrique de Shanghai is increasing its capital from 15 to 20 million fr. The new shares, of a value of 250 fr. each, are being offered to the existing shareholders at 260 fr. each at the rate of one new share for three old ones.

Calcutta Electric Supply Corporation, Ltd.—Final dividend on the ordinary share capital for the half-year ended December 31st, 1923, of 6 per cent. (actual), making 10 per cent. for the year, and in addition a bonus of 1 per cent. Annual meeting: May 14th.

Northwich Electric Supply Co., Ltd.—The net profits for 1923 totalled £4,204, plus £601 brought forward. After paying a dividend of 8 per cent. per annum and adding £700 to the reserve, £736 is carried forward.

Swiss Electrical Companies.—La Société des Usines Electriques de la Lonza, of Basle, is increasing its capital to the extent of 14,400,000 by the issue of 72,000 7 per cent. preference shares of 200 fr. each.

The Central Schweizerische Kraft Werke Gesellschaft, of Lucerne, is declaring a dividend of 8 per cent. for the last financial year.

City of Buenos Aires Tramways Co., Ltd.—Dividend of 1s. 3d. per share, less tax, being at the rate of 5 per cent. per annum for the three months ended March 31st.

Coventry Chain Co., Ltd.—Interim dividend of 5 per cent. actual, less tax, for the half-year.

Johnson & Phillips, Ltd.—Dividend for 1923 at the rate of 5 per cent. per annum on the ordinary shares, less tax, carrying forward £24,954.

International Automatic Telephone Co., Ltd.—Dividend of 4 per cent. for 1923 on the ordinary shares, carrying forward £5,708. For 1922 there was no dividend.

Electric Supply Corporation, Ltd.—Final dividend at the rate of 13 per cent. per annum, less tax, making 10 per cent. for the year.

Stocks and Shares.

MONDAY EVENING.

THE effects of the Stock Exchange satisfaction with the Budget are cumulative, and every day serves to increase the confident assurance that, under the present fiscal policy, prices of Stock Exchange securities, using the word "security" in its proper sense, are likely to move up in price. The belief is grounded, of course, upon the fact that national credit is being put upon a higher stand, which involves, necessarily, a lower return on invested money. The influence of such development permeates every investment department, with the result that prices are mostly moving upwards, not in any violent manner, but pursuing a steadily hardening process which testifies to the way in which floating supplies of stock are being absorbed.

At the same time, new issues are rapidly subscribed where these offer what the House calls good stuff. There is not the slightest indication of stockholders turning out their securities for the purpose of raising money for employment in trade and industry.

Interest has arisen in the likelihood of important steps being taken this month in connection with the London electricity supply industry. The two points that stand out more especially for consideration are the probable extension of the companies' term of life for forty years longer, and the institution of a sliding scale. The first obviously offers a cheerful prospect; the second impels caution on the part of the investor. For this reason, the market in electricity supply shares is quiet. Close students who have followed the fortunes of the industry over the past two decades, know that both these factors will come into play simultaneously: namely, the extension of life and the adoption of a sliding scale. In regard to the latter, the rough estimate is that a sliding scale would doubtless limit dividend distributions, but that the companies, free from the necessity of maintaining their present big reserve funds, would probably distribute these in the shape of shares, the dividends on which would compensate for whatever lower rate of distribution on the entire capital might be enforced through Parliamentary action. The companies would naturally have to keep reserves in hand, but there would be no longer any need for them to retain the substantial sums which prudence has dictated, hitherto, in view of the possibility that tenure of life might expire in 1931.

The Urban company has made its anxiously-expected dividend announcement, and is paying 4 per cent. on the ordinary shares. This is in accordance with the estimates of the more careful folk, though others of more cheerful temperament had been talking airily of a possible 6 per cent., and the price of Urbans has come back from £1 to 18s. 3d. Charing Cross ordinary weakened to 41s. 6d., and Edmundsons to 5; these are the only price-movements in the list.

Home Railway stocks are lower, Metropolitan losing 2, and Underground Electric "A" shares going back to 8s. Districts, however, maintain their big rise at 54½. Underground Income Bonds are steady at 97. The market in these Underground stocks is hanging, for its improvement, upon the progress of the work at the Exhibition. This is making rapid strides, and from the thousands of people who are now going to Wembley every day, it seems reasonable to assume that the success of the Exhibition when the show is complete, is certain.

In Metropolitan Consolidated stock, some people had bought more than they could conveniently finance, and thin sales led to the price going back to 80.

British Electric Traction ordinary has again risen, and now stands at 76, but no recovery is marked in London United Tramways debenture, nor in London and Suburban Traction shares. The foreign traction group is so quiet as to be almost unchanged, a modest improvement in Brazilian Tractions and a gain of 2, to 26, in Mexico Trams, being the only alterations.

The cable market is good, with further rises in Eastern Telegraph, Westerns and Globe Preference. Curiously enough, Globe ordinary are ¼ lower at 18, at which price they still stand above the other shares in this section. Anglo-American Telegraph deferred stock strengthened to 23¾. Having regard to the report issued the other day by the Western Union Telegraph Company which guarantees the Anglo-American dividends, the stocks of the latter make excellent investments. Anglo-American deferred pays nearly 6½ per cent. on the money, and stands out as being one of the cheapest of its kind. The name "deferred" is somewhat a misnomer, considering the security with which it is backed under the Western Union's agreement. The Western Union report showed a profit balance of 11½ million dollars for 1923. Dividends took seven million dollars, and the balance, added to the surplus brought in from 1922, left the huge total of nearly 52 million dollars to be carried forward to the current year.

Siemens have gained 1/16 at 17s. 6d. upon hopes that there may be a dividend this year. Babcock and Wilcox further advanced to 2 7/16: the dividend, making 12 per cent. for the year, goes against 20 per cent. for 1922 paid upon half the present capital. British Insulated are up to 50s. and Henleys have risen to within sixpence of this same price. General Electric keep firm at a guinea, and dividend guesses range from 5 per cent. upwards. A gain of 1s. makes Electric Supply ordinary 25s. Iron and steel shares are better, thanks to the genial optimism of the Chancellor of the Exchequer in respect to general trade. Rubber shares are dull and heavy in consequence of a decline, to a show below 1s. per lb., in the price of the raw produce.

Oriental Telephones are better at 1¾, but Marconis remain a dull market, and some little trepidation is felt in regard to what is likely to be the announcement from the Government in respect of the wireless chain, details of which are expected to be made public this week.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Dividend. 1922.	Dividend. 1923.	Price May 5, 1924.	Rise or fall.	Yield p.c.
Brompton Ordinary	1	12	10	87/-	—	*23 8 1
Charing Cross Ordinary	1	14	14½	41/6	—1/-	6 19 8
do. do. do. 4½ Pref.	1	4½	4½	17/-	—	5 6 0
Chelsea	1	10	12	1¾	—	6 8 0
City of London	1	15	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	23/6	—	5 2 9
County of London	1	10	15	45/9	—	6 11 0
do. do. 6 % Pref. ...	1	6	6	1¼	—	5 6 8
Edmundson's Ordinary	3	7	7	5	—¼	4 4 1
do. 6 % Pref.	5	6	6	5¼	—	5 17 1
Kensington Ordinary	5	12	14	10	—	7 0 0
London Electric	1	10	10	31/-	—	6 9 0
do. do. 6 % Pref. ...	5	6	6	5⅜	—	5 11 7
Metropolitan	1	8½	10	1⅞	—	5 14 3
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary ...	1	2½	6	18/9	—	6 8 1
do. 5 % Pref. ...	1	5	5	16/9	—	5 19 5
do. 7 % Pref. ...	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	21/3	—	5 13 0
Urban Ordinary	1	—	4	18/3	—1/9	4 7 8
do 6 % Pref. ...	1	5	6	1xd	—	6 0 0
St. James' and Pall Mall ...	5	14½	17½	13½	—	6 13 4
South London	1	11	15	42/-	—	6 7 2
South Metropolitan Pref. ...	1	7	7	1¼	—	5 12 0
Westminster Ordinary	5	12	15	10⅝	—	7 1 2
Whitehall Elec. Invst. 7½ % Pref.	1	7½	7½	20/6	—	7 6 4

Home Rails.

Central London Ord. Assented Stock	4	4	68½	—	5 16 10	
Metropolitan ... ... ,,	3½	4	80	—2	5 0 0	
do. District ... ... ,,	5	8½	54½	—	6 8 5	
Underground Electric Ordinary	10	Nil	Nil	3	—	Nil
do. do. "A" ...	1	Nil	Nil	8/-	—6d.	Nil
do. do. Income Bonds	5	6	97	—	*6 3 9	

Telegraphs and Telephones.

		Dividend. 1921	Dividend. 1922			
Anglo-Am. Tel. Pref.	Stock	6	6	102½xd	—	5 17 1
do. Def.	,,	1½	84/6	22⅝	+ ⅛	6 8 4
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7	—	10 0 0
Eastern Extension...	10	10	10	17½	—	5 16 8
Eastern Tel. Ord.	Stock	10	10	173½	+1	5 15 3
Globe Tel. and T. Ord.	10	10	10	18	—¼	5 11 1
do. do. Pref.	10	6	6	10⅝	+ ⅛	5 10 4
Great Northern Tel.	10	24	23	28½	+ ½	7 14 4
Indo-European	25	10	7	83½	+ 1	*5 6 1
Marconi	1	25	15	1⅞	—1/16	9 12 0
Oriental Telephone Ord.... ...	1	12	12	1¾	+ ⅛	*6 8 0
United R. Plate Tel.	5	8	8	7	—	*5 14 6
West India & Panama	10	Nil	Nil	1/-	—	Nil
Western Telegraph	10	10	10	17½	+ ⅛	5 16 9

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	12½	8¼	—	8 9 0
do. do. 2nd Pref. ...	5	Nil	5½	2½	—	10 4 4
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord. ...	,,	4½	5	76	+1	6 11 7
do. do. 6% Pref. ...	,,	6	6	99½	—	6 0 6
Brazil Traction	100	Nil	4	57½	+ ½	6 19 2
Brit. Columbia Elec. Ry. Pce.	Stock	5	5	84½	—	5 18 4
do. do. Preferred	,,	5	96/-	84½	—	*5 14 0
do. do. Deferred	,,	8	127/-	163	+ ½	*6 5 0
do. do. Deb.	,,	4½	4½	78½	—	5 8 3
Lond. & Sub. Trac. 5 % Pref. ...	1	8½	5	6/-	—	8 6 8
London United Tram. Deb. ...	Stock	4	4	47	—	8 10 2
Mexico Trams. 5% Bonds ...	—	Nil	Nil	73½	—	6 16 0
do 6% Bonds ...	—	Nil	Nil	80½	—	Nil
Mexican Light Common ...	100	Nil	Nil	22½	—	Nil
do. Pref.	100	Nil	Nil	46½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

Manufacturing Companies.

Babcock & Wilcox...	1	15	20	2¼	+ 1/16	*4 18 4
British Aluminium Ord.... ...	1	10	5	23/3	—	4 5 10
British Insulated Ord.	1	15	15	2½	+ ½	6 0 0
Callenders	1	15	15	48/9	—	6 3 0
do. 6½ Pref....	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅞	—	8 17 10
Edison-Swan	4/-	Nil	7½	8/-	—	6 0 0
do. ,, 5% Deb.	Stock	5	5	73½	—	6 7 5
Electric Construction	1	10	10	1⅝	—	6 7 8
English Electric	1	8	5	17/6	—	5 14 3
do. do. Pref.	1	6	6	19/-	—	6 6 4
Gen. Elec. Pref.	1	6½	6½	23/6	—	5 10 5
do. Ord.	1	10	5	21/-	—	4 15 9
Henley	1	15	15	49/6	+9d.	6 1 2
do. 4½ Pref.	5	4½	4½	4¾	—	5 9 1
India-Rubber	1	10	10	1¼	—	*7 5 8
Met.-Vickers Pref....	3	3	3	2⅞	—	6 11 3
Siemens Ord.	1	10	10	17/6	+ 1/16	Nil
Telegraph Con.	12	20	20	24	—	*5 0 0

* Dividends paid free of Income Tax.

Electrically Propelled Passenger Liners.

By A. REGNAULD, B.Sc. (Eng.) (Lond.), A.M.I.E.E.

In considering the possibilities of the application of the electric drive to the propulsion of merchant ships, investigators have usually been content to deal with the case of the low-speed cargo ship of average dimensions, rather than the passenger liner. The reasons for this are not very far to seek, since the cargo vessel forms by far the most important part of the British mercantile marine, while at the same time the power demanded for its propulsion is comparatively small—say, between two and three thousand horse power—and if it can be demonstrated that electrical machinery can be economically employed for the development of low powers, it is then only a matter of progress along accepted lines for it to be employed on vessels demanding higher powers. The majority of the merchant ships which have so far been equipped with the electric drive are cargo ships of average dimensions, and, therefore, of low power, although it may be recalled that in the United States Navy some of the largest and most powerful battleships are driven by electrical machinery. But despite the numerical superiority of the cargo vessel, the passenger ship also occupies a very important position in the merchant service, and neglecting the "ocean greyhounds" such as the *Aquitania* and the *Olympic*—after all these vessels are confined to the North Atlantic—there is a large number of liners of about 20,000 tons displacement arranged for the carriage of both passengers and cargo, and having a speed of about 16 knots. Vessels of this type are indeed responsible for the bulk of the mail and passenger services of the maritime countries of the world, and it is a matter of considerable interest, not only to shipowners and shipbuilders, but also to electrical engineers, to investigate the possibilities of employing electrical machinery for the propulsion of these vessels.

At the present time the 20,000-ton liner is generally propelled by means of geared steam turbines. In order to obtain an average sea speed of about 16 knots, the power required is in the region of from 12,000 to 14,000 horse power, and twin screws are usually employed. These screws for maximum efficiency must have a speed of rotation of about 100 revs. per min., so that using high-speed turbines for reasons of economy, double-reduction gearing is demanded between the turbine and the propeller shafts. This at once introduces a source of mechanical weakness. Experience has shown that double-reduction gearing is liable to failure due mainly to the effects of vibration and, while improvements in design and construction have tended to increase the reliability of these gears, many shipowners are still disinclined to employ them on their vessels, and we find that either the single-reduction gear is used, despite its obvious disadvantages, or the reciprocating engine is still fitted. A notable example of this is to be found in the P. & O. line, which still installs reciprocating steam engines even for its latest and largest vessels. On the other hand, one or two lines, notably the Union Castle, have decided to experiment with the direct Diesel engine drive for vessels of 20,000 tons displacement, and a few motor ships of this size are now under construction. But the limitation of the power of the Diesel engine will necessitate the use of quadruple screws if accepted designs of engine are installed, and while the economy should be greater than with steam turbines, there is much to be said against this arrangement.

The alternative to either the steam or the oil engine drive is electric propulsion, and as the power required is not excessive as compared with, say, a battleship, the steam turbo-electric drive can be ruled out so as to obtain at the outset the very great economy due to the use of Diesel engines. The problem then resolves itself into a determination of the possibilities of the Diesel-electric drive when the power required is in the region of about 13,000 h.p. Of the alternatives that have been considered above, the most economical and certainly the one which has in recent practice been most usually employed, is the geared turbine drive, the steam being obtained from oil-fired boilers. If it can be demonstrated that the 20,000-ton Diesel-electric liner is superior as regards the total inclusive cost of operating and maintaining than an oil-fired geared-turbine steamer of similar dimensions, a case will have been made out for the consideration of the former drive when new passenger tonnage is under consideration. Particular interest, therefore, attaches to a paper entitled "A 20,000-ton Diesel-electric Liner," which was read the other day by Mr. Percival J. Higgs, before the Institute of Marine Engineers. In his introductory remarks, Mr. Higgs emphasises the fact that the primary consideration with regard to any form of propulsion is to obtain the greatest return on the capital invested, and while admitting that this is often very difficult to estimate, in view of the many factors which enter into the problem, he proceeds to consider the cost of construction and of operation of a Diesel-electric liner in comparison with a geared-turbine liner, taking as far as possible every factor into consideration.

The equipment of the Diesel-electric vessel consists of eight high-speed six-cylinder engines coupled in tandem to four generators, these in turn supplying power to four motors arranged two in tandem on two propeller shafts. This installation he compares with the machinery of the Cunard liner *Scythia*, consisting of double-reduction geared turbines, and oil-fired boilers, the shaft horse power of which is 12,500, giving the vessel a speed of 16 knots. Allowing about 10 per cent. loss of power in the case of the electrical equipment, and taking 75 per cent. as the mechanical efficiency of the Diesel engines, the power developed by each engine works out to about 2,360 i.h.p., demanding six cylinders each 25 in. diameter by 25 in. stroke, and running at 240 revs. per min. Contrary to what is usually advocated with Diesel engines, Mr. Higgs adopts alternating-current machinery owing to the advantages of lower initial cost, more robust construction, and the fact that it requires less attention in service, factors which are of prime importance for marine installations. The main generators will be of 2,650 kW each, at 80 per cent. power factor, yielding 830 amperes at 2,300 volts; they will be wound three-phase, having 16 poles, thus giving at 240 r.p.m. a frequency of 32 cycles per second.

The excitation will be from the direct-current supply installed for the ship's lighting, and for operating the various auxiliaries. The motors are of the induction type wound three-phase, having 32 poles, and running, therefore, at 120 r.p.m., on 32 cycles, each motor developing about 3,190 h.p. The manœuvring and reversing is accomplished by means of external rheostats placed in series with the motor windings. In this way for quick reversing or for short periods of speed regulation, the whole operation can be done electrically without touching the Diesel controls. For speed control over long periods, the speed of the Diesels would be reduced, while at half power, which would give a speed reduction of 20 per cent., one engine in each line could be shut down.

In comparing the performance of these two vessels, the assumption is made that they are employed on the Atlantic service making the crossing in nine days, and, allowing for the usual periods in port, making an aver-

age of twelve round trips per annum. It is further estimated that the oil consumed for all purposes per shaft horse-power is 1.05 lb. on the steamship, and 0.504 lb. on the Diesel-electric ship. Then considering boiler oil to cost 45s. per ton, and Diesel oil to cost 60s. per ton, the vessel, of course, bunkering at the American port, the saving on fuel costs is estimated. This is found to be considerably in favour of the Diesel-electric ship. The question of the cost of the engine-room staffs is next considered, and this is estimated to be about the same in each case. The complement is taken as 40 on the Diesel-electric vessel, and 54 on the steamer, but a greater number of skilled engineers is required on the former type of vessel. The question of insurance and depreciation on the capital cost of the machinery installation is next considered, and here the figures are in favour of the turbine plant. It is estimated that the cost of the propelling machinery for the Diesel-electric vessel would be £150,000, as compared with only £100,000 for the geared-turbine ship, so that taking insurance (five per cent.) and depreciation (six per cent.) as the same for both vessels, the annual expenditure in this direction is determined. The cost of the vessel itself, less machinery, and the earning power due to number of cabins and size of holds, is also considered to be the same in each case, and thus a balance can be struck between capital expenditure, working expenses, income and profits. It is not necessary for us to give here the detailed figures as worked out by Mr. Higgs, neither is it necessary for us to deal, as he does, with the effect on profits of the variation in the cost of oil fuel. It may, however, be noted that taking the ratio of cost of Diesel oil to boiler oil as 4 : 3 the balance is always in favour of the Diesel-electric ship, the dividend at the prices given above being nine per cent. as against five per cent. If it becomes possible to run the Diesel engines on boiler oil—and the trend of Diesel-engine practice is in this direction—then the dividend becomes 12 per cent. for the Diesel-electric ship, as against 5 per cent. for the geared-turbine ship.

Thus, the Diesel-electric vessel, despite its greater initial cost, shows a greater return on the capital invested than does the oil-fired geared-turbine steamer, and, of course, a far greater return than does the reciprocating engined steamer. With regard to the very important question of reliability, only actual practical experience at sea can satisfactorily solve this question. It can be remarked, however, that the engines are of the high-speed, non-reversible type, totally-enclosed, and lubricated under pressure, all of which makes for reliability, and as the ordinary low-speed marine Diesel engine has shown itself to be thoroughly reliable under the exacting conditions met with at sea, there does not appear to be any reason why the Diesel-electric vessel should not be at least as reliable as the geared-turbine vessel, indeed, more reliable when one considers the troubles that have been experienced with many sets of double-reduction gearing.

There remains the direct-drive Diesel arrangement to which reference has already been made, but in view of the weight of the engines when running at low speed, and the difficulties as regards manœuvring and reversing, the advantages certainly appear to rest with the electrically-propelled vessel in which light high-speed engines are employed. In view, however, of the fact that one or two directly driven Diesel liners are under construction, it is to be hoped that the time will not be far distant when an actual comparison can be made with a vessel of the same size propelled by Diesel-electric machinery.

Service.

By "EN AVANT."

Much is being said at present about the necessity for service after sale if the domestic load is to be successfully developed. Undoubtedly, this branch of electrical development must be carefully nursed, but isn't it just possible that we are overdoing it?

When the supply authority in which I am interested first commenced encouraging the domestic load, we had the service "bee in our bonnet" badly, and I really think that some of our consumers, rather than clean their self-contained electric kettles when they became tarnished (as even electric kettles will), just used to burn them out and return them to us, receiving in exchange a nice new bright kettle. It is, at any rate, convincing that now we have started making a nominal charge for repairs, the number of burnouts has appreciably diminished.

There should undoubtedly be nominal charges made for repairs carried out to apparatus, as otherwise domestic application of electricity will never be considered in its true light. The public will continue to regard it as either an eccentric stunt of a philanthropic body or as a gamble with the ratepayers' money by a scheming municipality (according to their views on municipal trading), instead of what it really is, namely, an absolute necessity to a decent, hygienic standard of living.

After all, why should such super-generous treatment be given?

A boot manufacturer does not repair free of charge for evermore the boots that he put on the market, and yet he runs the risk of competition every bit as much as we do in the electrical profession.

If domestic apparatus is still in such a primitive state as to involve large repair bills every year, then it cannot possibly be doing the industry any good to put such apparatus before the public.

If, on the other hand, the apparatus has reached that stage of reasonable efficiency which we claim for it, then the consumer could not with any fairness complain at occasional little repair bills.

Service should be confined to prompt attention to breakdowns which may occur, both of apparatus and supply distribution, and the elimination of these as far as is possible, and courteous, tactful help from the sales representatives and lady demonstrator, which now brings me to another subject.

I notice that in his paper read recently at an E.D.A. Salesmanship Conference, Mr. Lower, of Norwich, suggests that it is useful and desirable for the sales representative to have a cooker in his own home, so that he may take his prospective clients home and let his wife talk to them.

I suggest that when the value of the representative, who has to be a technical man, a successful diplomat, and have a pleasing and tidy appearance, is recognised in a material way, then there are many canvassers who will be only too pleased to take unto themselves both a wife and a cooker.

Personally, I think that it illustrates the lamentable lack of organisation and commercial sense, which unfortunately still exists in the electrical industry, that the most important link between the consumer and the supply authority, the sales representative is paid very little more (if any) than a junior clerk of the undertaking, and certainly in the majority of cases considerably less than a Trade Union wireman, and until this is rectified it will be absolutely impossible to attract a man with the necessary initiative, training, and experience, and of good general education and breeding to this sort of job.

Faithful Reproduction in Radio-Telephony.

(Abstract of paper read before the WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper on the above-named subject that was recently read by Mr. L. C. Pocock, B.Sc., A.C.G.I., A.M.I.E.E., is divided into two sections: In Part I it is pointed out that it is not possible in a single paper to explore in detail all the possibilities of distortion. The proper understanding and application of certain general principles enable individual circumstances to be examined and indicate the path to be taken in the pursuit of high-quality transmission. Therefore an attempt has been made, first, to define terms suitable to the scientific study of faithful reproduction; secondly, to analyse into separate constituents the types of distortion occurring; and, thirdly, to lay down the general principles above referred to and give them as far as possible a mathematical form. This has been done, not only for the purpose of ensuring precision and definiteness of statement, but also to enable quantitative application to be made and to prepare a foundation on which to build as knowledge of the subject progresses. Special consideration has been given to transient phenomena because in much of the apparatus used for radio-telephony the ordinary forms of steady state distortion can be reduced to a negligible amount. The consideration is, however, of a preliminary nature only, the study of transients not having been taken beyond the simple cases of "ironless" circuits. A difficult field left open for investigation is the exploration of transient phenomena in circuits having impedance operators that are not single-valued functions.

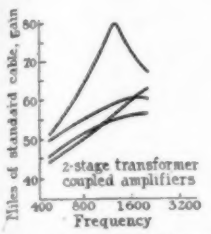


Fig. 1.—Frequency-distortion of Speech-frequency Amplifiers.

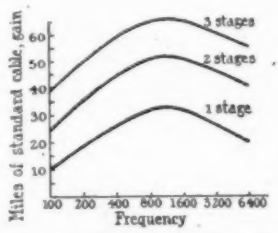


Fig. 2.—Frequency-distortion of Loud-speaker Amplifier.

In Part II the principal types of apparatus employed in radio-telephony have been considered in as general a way as possible.

The transmitter must fulfil the following conditions:—Its electrical voltage output at all frequencies from 20 per second up to some undetermined high audio frequency—say, about 10,000 per second—must be a faithful reproduction of the pressure in the air due to the sound to be transmitted, which implies absence of frequency and amplitude distortion both symmetrical and asymmetrical.

The carbon transmitter used in ordinary telephony depends for its efficiency upon the judicious use of a certain amount of resonance, permitting unavoidably a definite and known amount of frequency distortion; it is, moreover, guilty of amplitude distortion, as any instrument must be which operates by the variation of resistance unless the resistance variation is very small. Asymmetrical distortion is also present, due to the non-linear variation of carbon resistance with pressure (unless it is specially compensated as in what is known as a push-pull arrangement). No high-quality transmitter can at present be made with anything like the same transmitting efficiency. This is, however, not serious. Thanks to the high degree of distortionless amplification obtainable by valves, the lower limit of permissible efficiency is only controlled by the degree of electrical disturbance picked up by the transmitter leads, and the amount of noise inherent in the early stages of the amplifying system.

Excellent transmitters can be made by securing very high natural frequencies with high damping in the mechanical system, and there is then not much difficulty in avoiding amplitude distortion. Electrical and acoustical resonances, as much as mechanical resonances, must be avoided in connection with the transmitter as elsewhere.

Five types are in use at present. In the condenser transmitter a light and tightly stretched diaphragm, heavily damped, forms a small condenser which varies in capacity with the pressure of the air. If a steady voltage is applied through a resistance across which connection is made to the amplifier, the alternating voltage across the resistance will be proportional to the current flowing when the condenser capacity varies. For the minute alterations of capacity resulting from the varying pressure of sound incident on the diaphragm the amplitude distortion is negligible, and the combination of damping and high natural frequency (about 16,000 p.p.s.) gives an almost flat frequency characteristic.

In the "push-pull" carbon transmitter a similar highly-damped diaphragm operates on two carbon buttons, one on each side and so connected as to compensate mutually for the non-linear carbon distortion. The variations of resistance are so small that the amplitude distortion arising from the reciprocal relation between pressure and current is quite negligible.

In the electromagnetic transmitter a light coil with very little stiffness is made to vibrate in a magnetic field by the sound waves; the damping is partly mechanical and partly electrical. The output voltage varies directly as the frequency. The natural frequency is probably low, so that the variation of output with frequency partly compensates for the falling amplitude/frequency characteristic of the vibration, and the frequency distortion can be corrected by suitable inductance.

A fourth type operates by the direct action of sound waves on a silent glow discharge provided by a third intermediate electrode. It is possible to control the frequency distortion and to procure a practically flat characteristic by suitable adjustment.

In a fifth type, developed in Germany, sound waves influence the current flowing across an ionised air space between a Nernst glower and a cold electrode.

The remarks about amplification apply equally to audio-frequency amplifiers. Criticism of speech amplifiers appears to have some foundation; fig. 1 is a reproduction of curves of four representative makes of speech-frequency amplifiers for radio work, published by the American Bureau of Standards. Fig. 2 is the curve of a loud-speaker amplifier. To a telephone engineer these response characteristics are an amazing revelation; figs. 3 and 4 show characteristics of good amplifiers for radio-telephony employing either inductance and condenser or transformer coupling, and should settle definitely, whether or not amplification without distortion is possible, at least as far as frequency distortion is concerned. Amplitude distortion can readily be reduced to an almost negligible amount. The conditions for avoiding distortion are:—(*a*) The amplifying valve grid-voltage/plate-current characteristic under the working conditions must be linear over a certain range, and the instantaneous voltage applied to the grid circuit must always lie between the values of abscissæ which correspond to the limits of linearity. These conditions will be approximately fulfilled when the valve has suitable capacity for the work it has to do if the grid voltage and plate voltage are correctly chosen. A rough guide is that the maximum alternating voltage applied to the grid should not exceed the amount of the grid bias (including any due to a high-resistance leak in series with the biasing potential).

Resistance coupling gives very good quality, and freedom from frequency distortion is easily secured, but a large part of the effective alternating e.m.f. in the plate circuit is lost unless an extremely high-voltage plate battery is used. For inductance and capacity coupling the inductance must be large enough to offer an impedance high in comparison with the tube impedance at the lowest frequencies to be transmitted, and at the same time the winding must be so arranged that the self-capacity of the coil does not approach the resonance condition at a frequency within the range to be amplified. The core must be sufficiently generously designed to prevent saturation by the plate current flowing in the windings.

Transformer coupling has the greatest overall efficiency, but presents the greatest difficulty in avoiding distortion. The primary must meet the conditions specified for inductance coupling, while the secondary, in order to get a voltage transformation of four or five, must have an impedance from 16 to 25 times as high as the primary. Under these conditions the capacity of the secondary winding is only to be prevented from having serious resonance effects by extremely careful design. The hysteresis effect must also be kept low to avoid asymmetrical distortion.

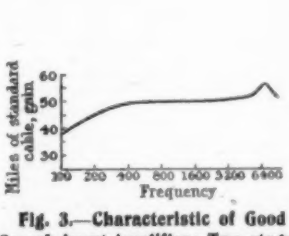


Fig. 3.—Characteristic of Good Speech-Input Amplifier; Two-stage.

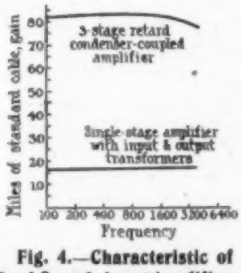


Fig. 4.—Characteristic of Good Speech-Input Amplifiers.

Another distortion, somewhat more common than it should be in audio-frequency amplifiers, is due to the curvature of the BH characteristic of iron, which causes a certain amount of amplitude distortion. From the point of view of frequency as well as amplitude distortion a generously designed iron circuit is necessary. Thermionic tubes cannot be perfectly unilateral in their behaviour, and consequently distortion may

result if the input impedance varies greatly with the frequency. Distortion of wave-form can be avoided by making the external plate-circuit impedance high.

Reference must also be made, on account of its probable effect upon transients, to the phase distortion arising from reactive impedance in the plate circuit.

There is an upper limit to the inductance in the plate circuit, because the input impedance of the tube has an increasingly large negative resistance component for increasing plate-circuit inductances, and this tends towards oscillation; even although actual oscillation does not occur, this condition must not be approached or excessive amplification of frequencies in the neighbourhood of the natural frequency of the system will result.

A moderate degree of reaction is legitimately used to increase the sharpness of tuning when receiving faint or long-distance telephony. If, however, the reaction is taken too far the curve of aerial current against frequency for constant applied voltage becomes sharply peaked, and the range of frequencies corresponding to the signal no longer lies on a sensibly flat part of the resonance curve, so that there is frequency distortion; also abrupt variations in the applied voltage will not be faithfully followed by the aerial current if the damping is made very low, but instead the aerial will set up a damped train of oscillations at its natural frequency at each transient change, and these when rectified appear as noise. The Armstrong circuit, in which high reaction is used together with a quenching device that prevents continuous oscillation, is valuable for long-distance commercial communication, but cannot under any circumstances be considered as a high-quality receiving system, because the high reaction introduces frequency distortion and the periodic quenching of free oscillations introduces slight noise due to the audible components of the damped trains of waves. Attempts are occasionally made to apply the principle of reaction to audio-frequency amplifiers, but no important developments are to be looked for along these lines.

Dual amplification or reflex circuits are, in general, not satisfactory from the point of view of high quality, because the vacuum tube operates as an amplifier in both its functions, but the radio and audio frequencies have to be separated by condensers, which cause appreciable distortion in the audio-frequency circuit.

Where crystal sets or amplifiers of low power having good characteristics are used with head receivers, excellent quality can be obtained; naturalness also is probably good. The general theory by which the vibration constants are studied has been described by the author elsewhere The data accumulated by this method, together with Dr. Kennelly's methods of impedance analysis and modern research, have placed receiver design on a sound scientific basis, to which strong testimony is borne by the fact that the first receiver designed by the new methods had an acoustic power output about 2½ times greater than previous receivers for the same power input, although it was actually smaller and lighter. Of all the transformations to which the speech or music is submitted, the final one into acoustic waves by a loud-speaking receiver is the least satisfactory. It is possible to secure intelligibility commensurate with that of a head receiver, but in speech naturalness and musical faithfulness the diversities of reproduction are about as numerous as their types.

The receiver mechanism will not handle more than a certain amount of power without serious amplitude distortion; the receiver should handle as much electrical speech power without distortion as the valve which precedes it. Both must, however, be capable of dealing with the maximum peak voltages occurring, whether due to a peaky wave-form or to the varying intensity occurring pre-eminently in music. A given valve and loud-speaking receiver will only reproduce music without bad distortion on loud notes at an average intensity considerably lower than that at which they can reproduce speech satisfactorily. Also in estimating the permissible variation of grid potential from any data obtained by measurement of the r.m.s. value of speech currents, an amplitude factor must be used to provide for the high peakiness of the wave-form.

As a very rough approximation, it may be stated that a good loud-speaking receiver may require from 0.0003 to 0.0005 apparents watt in order to give out speech at a convenient volume level in a moderate-size living room; the apparent wattage is supposed measured by the product of mean squared current and effective resistance (at 800 periods per second) of the receiver. Allowing that the peaks of the voltage wave are seven times the r.m.s. value, it is easy to calculate that a valve of moderate power is required to give a good performance with speech, while a further margin is required to take care of the wide variation of intensity in music.

The inductance of the receiver circuit should be kept low relatively to the resistance as well as the mass of the moving parts, but the effective inductance under working conditions plays no useful part and is analagous to the leakage flux and magnetisation inductance of a transformer; a 100 per cent. efficient receiver need have no effective inductance.

Frequency distortion in loud-speaking receivers is the most serious problem of high-quality radio-telephony. The distortion of all the other apparatus used in radio-telephony can be brought down to reasonably small dimensions; in the loud-speaking receiver such an equally near approach to perfection is still possible, but not as yet at a commercial cost. Electro-magnetic receivers can only be made of sufficiently high efficiency to enable them to be used with moderately-powered valves by employing mechanical resonance; it is by the sparing use of resonance, entailing perhaps the sacrifice of a certain amount of volume efficiency, that high quality can at present be secured.

At present very little can be done to reduce noise (other than distortion noise) in circumstances where it is serious. High selectivity tends to reduce the noise received when it is spread over a spectrum of wave-lengths; the use of a coil aerial may by its directional effect also enable the ratio of signal to noise to be raised. Other devices to eliminate wave-lengths near to that being received do not eliminate the extra frequencies due to amplitude distortion.

Ships' Auxiliary Machinery.

The Electric Motor Drive.

By L. MILLER, A.M.I.E.E.

(Abstract of paper read before the INSTITUTE OF MARINE ENGINEERS.)

THE object of this paper is to review the position of the electric-motor drive of the auxiliary machinery on board ship and to weigh the advantages to be obtained from the adoption of this type of drive. It has become almost standard practice to fit compound-wound d.c. generators on board ship. The usual alternator used for ship work is the 3-phase machine; both 3-phase squirrel-cage and wound-rotor slip-ring motors and d.c. series-wound as well as shunt-wound constant- and variable-speed motors have been used on board ship for driving auxiliary machinery.

Three vital points in motors for use on board ship are: (1) The insulation must be of the very best, and capable of withstanding the action of steam, oil, and salt water. (2) Motors in the engine room, or similar locations, operating on continuous duty should be protected from the action of steam, oil, falling water, and dirt without interfering with ventilation; motors on the weather deck which will be operating on intermittent duty must be totally enclosed, water-tight, and capable of withstanding the blow of a heavy sea. (3) The bearing should be such that the motor will operate satisfactorily with at least a 20 deg. roll. This means that ball or roller bearings should be used, or ring-lubricated bearings should be made with sufficient clearance to prevent the rings jamming and precautions should be taken that hammering is not set up by the motor armature floating.

Motors should always if possible be placed with their shafts pointing in a fore or aft direction. This remark does not apply to cargo-handling machinery which will normally be used with the ship stationary. Totally enclosed motors for continuous duty in the engine-room should never be used unless special means are taken to get rid of their heat.

At present the majority of motors used on board ship are of the direct-current type. There are, however, 25 tankers at sea equipped with alternating-current motors driving the engine room auxiliaries and the steering gear, and, in two instances, the cargo oil pumps, but this fleet of tankers appears to be the only example of a.c. motors at present in use. It is somewhat difficult to assign any definite reason why a.c. motors have not been used more frequently. Most engine room auxiliaries are of the constant-speed type, and such pumps as require regulation in the amount of liquid passed can be controlled on the suction or discharge sides. Forced draught can be controlled by the dampers or louvres in the discharge air trunk. Under these conditions the a.c. squirrel-cage motor is almost ideal for ship conditions owing to its robust construction and the absence of rotating current-collecting gear. The elimination of the commutator and its brushes is of great importance and simplifies the maintenance a great deal. Apart from these reasons, however, another reason for its adoption is the important fact that it is cheaper than the d.c. motor.

There is no doubt at all that on ships such as tankers

where there are practically no winches and where only the engine room, steering gear, and similar constant-speed applications have to be considered the alternating squirrel-cage motor is practically ideal. Unfortunately the constant-speed characteristic of the a.c. motor is very much against it when applied to winches or cargo-handling machinery.

Centrifugal pumps have been used for cargo oil with satisfactory results, and the motor drive is also applicable to the reciprocating type of pump which is generally regarded as essential for dealing with the very heavy variety of oil. Owing to the fire risk this application calls for special treatment and on two installations a.c. squirrel-cage motors were used in order to be able to use a motor without current collecting gear. A flame tight motor was not regarded as a sound solution as it would have meant the use of a totally enclosed motor on continuous duty; it was therefore decided to totally enclose the motors but to ventilate them by means of ducts connected to a motor-driven blower located in a suitable deck house from which a supply of fresh air can be obtained. To prevent any trouble from short circuits in the cables feeding the motor these were taken down the ventilating pipe. This arrangement maintains the air in the motor casing and piping at a higher pressure than the outside atmosphere so that oil fumes cannot leak into them; the blower is run for a predetermined time before the main pump motor is started up, thus ensuring that the casing is clear of fumes. This arrangement is automatic; closing the master switch puts into action the whole of the gear.

Stores refrigerating machines and air compressors are similar as regards the type of motor required to drive them. Both are usually equipped with a flywheel, and for this reason if d.c. power is available the motor should be fitted with a series winding to enable the speed to drop sufficiently with load for the flywheel to smooth out the power taken from the generators. If a.c. is available the same result can be obtained by using a slip-ring motor and leaving a small amount of resistance in the rotor circuit.

Probably the best arrangement for the all-electric steering gear is that embodying Ward Leonard control; electro-hydraulic steering gear may be of either the Williams Janney or Hele Shaw type. It is usual to put in motors very much too large for their work on this very vital service, and it is always advisable to have a stand-by motor in the steering flat ready to slip into place. Fuses should never be fitted in the circuit of the steering gear motor, and devices should be fitted such that, in the event of the motor shutting down, the bridge and engine room are at once advised.

The best type of motor for driving cargo winches is series or compound wound and has a magnetic brake; a centrifugal brake; and, if necessary, a slipping clutch embodied in the design. The slipping clutch is useful to prevent damage in the event of the hook catching the hatch coaming, but is not an essential detail. In addition the motor must be water-tight and capable of withstanding the blow of a heavy sea. The control gear should be of the contactor type, operated by a master controller, and the arrangement should be such that the control lever or handwheel can be thrown into any position without damage to the equipment. Embodied in the control gear should be a device which, when the load falls below a predetermined amount, raises the speed of the motor by reducing the field.

The half-hour rating gives sufficient margin to cover all the duties that a winch is required to perform. It has been found also in practice that the maximum number of duty cycles that a winch performs in one hour is approximately 30. Windlass and capstan motors require about the same rating as winch motors. In the case of windlass motors it is, however, essential that the full load rating be based on the maximum power the windlass may be required to exert.

The consumption of the steam-driven auxiliaries is double and in many cases more than double, that required for the necessary feed water heating. This betrays a very wasteful and uneconomical condition. Taking the consumption of the main propulsion unit of a 2,500-s.h.p. vessel at 10 lb. per s.h.p. hour and the power taken by the auxiliaries on voyage load at 4 per cent. of the s.h.p., then with the electric drive of auxiliaries utilising a geared turbo-generator the steam consumption when developing 4 per cent. of the power of the main unit (taking steam at 36 lb. per b.h.p. per hour at the couplings of the motor) will be 14.4 per cent. of the consumption of the main unit. For steam-driven auxiliaries, taking steam at 75 lb. per b.h.p., the auxiliary consumption will be 30 per cent. of the main propulsion unit. The steam consumption of the geared turbine set is just about sufficient to give economical feed water heating, and practically the whole of this steam can be utilised for feed water heating under these conditions.

Assuming oil is used for raising steam, then the oil consumption directly assignable to the auxiliaries will be 14.4 per cent. of that required for the main units for the electric drive and 30 per cent. for the steam drive. The same advantage of feed-water heating can be obtained by bleeding from the lower stages of the main unit for an increase of steam consumption of the main unit not amounting to more than 4 per cent. with a 29-in. vacuum. With a smaller vacuum the increase in consumption will be less. If a Diesel or semi-Diesel-driven generator is used to provide power for the auxiliaries then the fuel consumption of this unit producing 4 per cent. of the s.h.p. at the motor coupling will not amount to more than 3 per cent. of that of the main unit. Therefore with the Diesel-driven auxiliary generator a saving of over 7 per cent. in fuel consumption can be shown over the steam-driven auxiliary generator and 23 per cent. over direct steam-driven auxiliaries, providing none of the excess steam is passed into the l.p. stages of the main turbine. If the excess steam is passed into the l.p. stages of the main turbine the saving is about 14 per cent.

The port load will in general be slightly more than the voyage load and will amount to at least 5 per cent. of the s.h.p. of the ship in the majority of cases. For the electric drive, utilising a geared turbo-generator, the fuel consumption when working cargo will be 15 per cent. of the fuel consumption of the main unit. For the electric drive, utilising a Diesel-driven generator, the figure will be from 3 to 4 per cent., and for steam-driven winches 40 per cent.

On an oil engine-driven ship the effect of using an exhaust heat boiler should be considered. Such an arrangement is only feasible during the voyage, and Diesel-driven generators must be installed to handle the port load with the usual stand-by. Usually at least 1.0 lb. of water can be evaporated per b.h.p. of the engine in exhaust heat boilers with exhaust gases at 600 deg. F. These figures have been borne out in practice. The voyage load is usually about 2.5 or 3.0 per cent. of the s.h.p. of the main engine, and assuming that 36 lb. of steam per b.h.p. at the motor couplings would be required to run a small turbo-generator, then only just sufficient steam would be raised to cover the voyage load. In fact, if the auxiliary load did amount to 3 per cent. of the s.h.p., then the steam raised would hardly be sufficient. The saving due to the use of the exhaust heat boiler is small in any case, due to the small amount of auxiliary load under voyage conditions. However, in the case of a ship operating on such a trade where the time spent at sea is a very great proportion of its operating time, then the use of the exhaust heat boiler is worthy of consideration. Where short trips are taken and the time unloading and in port is nearly as much or greater than the time at sea, then the exhaust heat boiler cannot justify itself.

Steam-driven auxiliaries will have a fuel consumption of 47 per cent. of the main propulsion units and electrically-driven auxiliaries a consumption of 4.5 per cent. of the main propulsion unit in 4-cycle Diesel-engined ships. In ships equipped with 2-cycle Diesel engines, if motor-driven scavenging pumps are used of the turbo blower type, the power required will be very considerably increased and will amount to from 20 to 25 per cent. of the s.h.p. and the saving due to the electric drive will be correspondingly increased. The steam consumption of a large unit like the turbo blower will, however, be considerably better than that obtained from the average auxiliary engine, and will be comparable to the usual turbo-generator, say, 29 lb. of steam per b.h.p. per hour. In this case steam-driven auxiliaries would consume approximately 150 per cent. of the fuel demanded by the main propulsion unit and electrically-driven auxiliaries 38 per cent.

In the case of the port load, steam-driven auxiliaries will have a fuel consumption of 50 per cent., and electrically-driven auxiliaries 7.5 per cent. of the main propulsion unit. A very important advantage of the use of a Diesel-driven generator lies in the fact that full power will be available at any time without having to keep steam up and look after banked fires.

Battery Electrolyte Impurities.—A new method of measuring the rate of sulphation of storage-battery plates was recently devised at the Bureau of Standards by Vinal and Ritchie (Technologic Paper 225). This consisted of periodic weighings of plates suspended in electrolyte, and a paper in the April issue of the A.I.E.E. *Journal* is an extension of this work. Detrimental impurities, when present in the solution, may corrode the plate, accelerate the formation of lead sulphate, or be deposited in the pores of the plate. In any case, the weight of the plate changes, and this affords the most sensitive and exact means for estimating the extent and nature of the reaction. A physical meaning can be given to the rather vague term "local action." It was found that electrolyte, containing only one part of platinum in ten million parts of the solution, increased the local action at the negative plates by 50 per cent. Copper, like platinum, deposits on the negative plates, but produces less effect. Iron is of unusual interest because it greatly accelerates the formation of lead sulphate at the negative plate. The reaction of the positive plates is slower, which mitigates its detrimental effects to some extent. Manganese is particularly destructive to the positive plates. The results of the experiments indicate that the reactions of manganese compounds in the battery are somewhat different from the previously accepted theories. Manganese in the form of manganise dioxide is deposited on the positive plates covering the active material, closing the pores, and causing a part of the charging current to be wasted. The work is being extended to include the effect of other impurities.

Hart Accumulator Strike Ended.—The strike at the Hart Accumulator Works, Stratford, in which about 350 men were involved, came to an end last week. About 150 men resumed work on May 2nd, and the company has undertaken to reinstate the remainder in from four to six weeks.

The Klydonograph.

An Instrument for Recording Voltage Surges.

A NEW instrument, known as the "Klydonograph," has been developed by Mr. J. F. Peters, of the Westinghouse Electric and Manufacturing Co., for recording abnormal voltages on transmission lines. With this instrument a graphic record of voltage surges of extremely short duration can be obtained, giving their polarity, magnitude, steepness of application, &c.

The new instrument is based on an old principle first observed in 1777 by Dr. Lichtenburg, and makes use of figures known as Lichtenburg figures. Dr. Lichtenburg found that, if he discharged a condenser, such as a Leyden jar, across a spark gap on to a terminal in contact with an insulating plate placed between this terminal and an earth plate, and then removed the terminal and sprinkled powder on the plate, the powder would arrange itself in a figure that had a very peculiar appearance. In 1888, Messrs. J. Brown and E. Trouvelot found that with the insulating plate replaced by a sensitized photographic plate, the emulsion in contact with the terminal, figures very similar to those of Lichtenburg were created and appeared upon development.

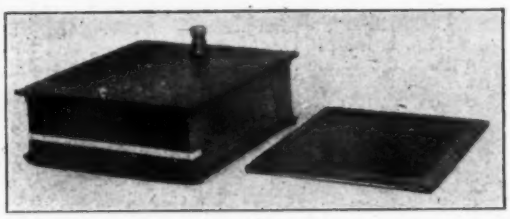


Fig. 1.—Klydonograph for Practical Application.

The Klydonograph in its simplest form is indicated in fig. 2. The photographic plate, of course, must be in a dark box. If a voltage is impressed between the terminal and the ground plate, as at E, on developing the photographic plate figures will appear that will give information concerning the nature of the voltage impressed. If, for instance, the voltage is in the form of a surge that is unidirectional, with a sheer front or a tapered front, the figure of the photographic plate will differentiate between the tapered front and the abrupt front, and it will also indicate whether the surge was of positive or negative polarity. The diameters of the figures also give a measure of the magnitude of the surges, although the positive and negative figures have quite different calibrations, the figure for the positive surge being considerably larger than that for the negative surge of the same magnitude.

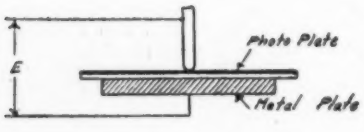


Fig. 2.—Diagram Drawing of a Klydonograph.

For practical application the instrument is made continuously operative, and is capable of recording the exact time of the occurrence of the disturbance. Fig. 1 shows a Klydonograph suitable for such application. This instrument makes use of a 10 × 12-in. plate in a special plate holder. The moving parts are driven by a clock that makes one complete revolution in 24 hours. Fig. 3 shows a method of connecting the Klydonograph to the line. Since this instrument is practically a zero current device, it is possible to connect it to the line electrostatically. This makes it possible to connect it to a high-voltage line without introducing an insulation hazard. With the Klydonograph connected as shown, the figures produced give the magnitude and polarity of the surges.

Fig. 4 shows a method of connection that will give the steepness of the surge front. A counterpoise is run underneath or alongside the transmission line for 1,000 or 2,000 ft., with the far end earthed directly and the near end earthed through a high impedance. The Klydonograph is then connected across this high impedance to ground. The voltage induced in the counterpoise is a measure of the steepness of the current wave, and since the current wave and the voltage wave have exactly the same shape, it gives a measure of the steepness of the surge front. By comparing simultaneous readings of two Klydonographs, one connected to the line through the electrostatic potentiometer and the other to the counterpoise, the following information concerning the surge can be obtained: Magnitude, polarity, steepness of front, and the direction in which the surge is travelling on the transmission line. Magnitude and polarity are obtained directly from the first Klydonograph, steepness of front directly from the second, and from the relative polarity of the two figures the direction in which the surge is travelling is obtained, that is, if the polarity of the two figures is the same, the surge is of the same polarity and is travelling in a direction fixed by the manner in which the recorders are connected to the system. If the figures are of different polarity, the surge is of the polarity indicated by the recorder connected to the potentiometer and is going in the opposite direction to the one previously mentioned. Figs. 5 and 6 show typical records of positive and negative surges with abrupt fronts.

Fig. 5.—Figure made by a Positive Surge with an Abrupt Front.

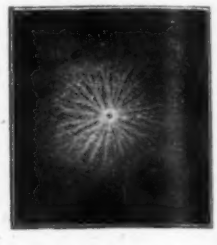


Fig. 6.—A Negative Surge with an Abrupt Front.

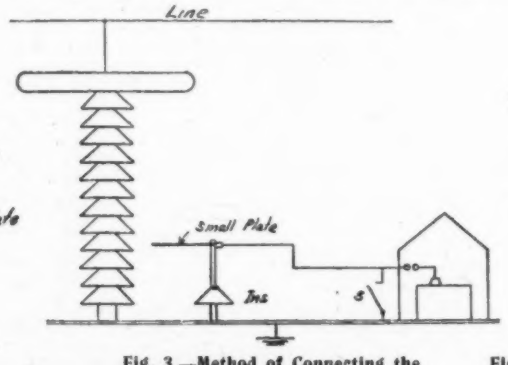


Fig. 3.—Method of Connecting the Klydonograph to the Line.

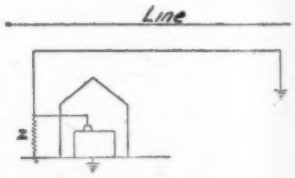


Fig. 4.—Method of Connection to give Steepness of the Surge Front.

International Labour Conferences.—We are asked to direct attention to the forthcoming summer schools of the League of Nations Union, to be held at Oxford and Geneva. The first Geneva visit will be held from June 14th-21st (fee nine guineas); the party leaves London on June 14th, arriving at Geneva on June 15th, to attend the first week of the sixth session of the International Labour Conference. A lecture explaining the history and work of the International Labour Organisation will be given by Mr. Lothian Small, M.A., before the conference opens. The Summer School, Oxford, will extend from August 1st to 8th (fee 4¼ guineas). It will afford an opportunity for study and discussion of the work of the League of Nations and its International Labour Organisation, combined with the charm of a holiday in Oxford, and optional excursions on the river and to the Cotswolds. Among the lecturers are Miss Margaret Bondfield, M. Arthur Fontaine, Dr. Maxwell Garnett, Dame Edith Lyttelton, Major-General Sir Frederick Maurice, Prof. Gilbert Murray, and Lord Phillimore. The Summer School, Geneva, will be held from August 8th to 18th (fee 11¼ guineas). Any of our readers who may be able to take part in these interesting proceedings can obtain further particulars from the Secretary, League of Nations Union, 15, Grosvenor Crescent, S.W.1.

Charing Cross Street Lighting.

THE General Electric Co., Ltd., has recently secured an order from the Charing Cross, West End & City Electricity Supply Co., Ltd., to supply lanterns and "Osram" gasfilled lamps for the street lighting of the Charing Cross area. As this comprises some of the most important thoroughfares and traffic junctions in the world, it will be instructive to study some

Fig. 1.—A G.E.C. Street-lighting Lantern.

of the features of the lantern which has been selected, and the reasons for its selection.

Its general appearance will be seen by reference to fig. 1; the construction throughout is of a substantial and durable character.

Features of outstanding interest in the equipment are the patented ventilating device, operating upon the ejector principle, and combining to an unusual degree both simplicity and efficiency; an extremely ingenious focusing device in which, by a half turn of a screw located upon the exterior of the lantern, the lamp can instantly be adjusted to any desired position; and terminals of special construction which, for quality of insulation, ease of connection and disconnection and reliability of contact, leave little to be desired.

As instancing the efficient nature of the ventilation and air circulation provided it may be stated that at the end of a continuous run of 1,000 hours the drop in candle power of a 1,000-W lamp in a lantern amounted to only 15 per cent. Still more remarkable is the fact that at the expiration of a continuous run of 350 hours the candle power of the lamp

Fig. 2.—Lighting Installation in Cockspur Street.

in the lantern was actually higher than that of a similar lamp burning in the open.

In one test the lanterns were subjected for long periods to conditions analogous to those experienced under very heavy rain propelled by a driving wind of hurricane force. Artificial rain was produced by forcing water through the perforations in a horizontal pipe, and the lanterns were hung as close together as possible in order to produce the maximum of cross splash. In addition, water at a pressure of 85 lb. to the square inch was projected upon the lanterns from a number of jets fixed at various angles with the object of determining whether it was possible to break down the weather-resisting properties of the ventilating tops. Notwithstanding that the conditions produced were such as to exceed in severity anything remotely likely to be experienced in practice, and that they were maintained for periods of 24 hours at a time, no trace of water was found in the interior of any of the lanterns, nor were any lamp failures experienced other than those due to the expiration of the normal lamp life. It is of interest to note in this connection that the whole of the lanterns at present in service passed through the severe snowstorms in March without the slightest trouble being experienced due to surface leakage across the terminals or the entrance of moisture to the interior.

Fig. 2 shows the lamps installed at the Charing Cross end of Cockspur Street. The standards, which previously carried other light sources, are spaced at distances varying from 100 to 160 ft. apart, according to the particular locality in which they are installed, and are so designed as to give a height from the roadway to the lamp filament of 25 ft.

Two lanterns, each equipped with a prismatic glass refractor and a single 1,500-W clear "Osram" gasfilled lamp, are used on each of the standards, and the minimum horizontal illumination between the two standards shown in the illustration is 0.4 foot-candle on a plane three feet above ground level. There is a total absence of "glare." We reproduce in fig. 3 a polar curve of a single lantern provided with the prismatic refractor normally supplied, and equipped with a 1,000-W "Osram" gasfilled lamp and a clear glass outer globe.

The light emission is excellent for street lighting purposes, th maximum candle power of 2,680 being given at an angle of 70 deg. from the vertical.

The horizontal illumination given by two such lanterns suspended at a height of 25 ft. from ground level to centre of filament, and spaced 100 ft. apart, at a point approximately four feet from the base of the standards is 2.89 foot-candles,

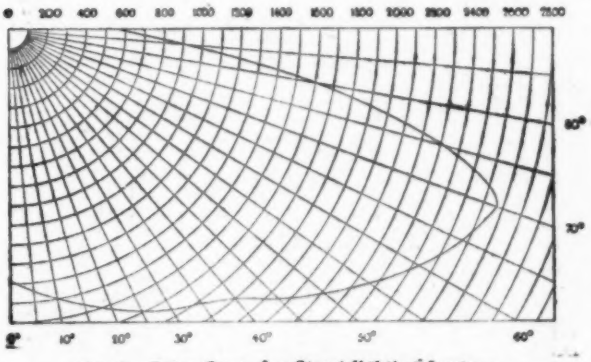


Fig. 3.—Polar Curve for Street-lighting Lantern.

the minimum illumination midway between the standards is 0.90 foot-candles, and the average intensity over a line between the standards is 1.75 foot candles.

The spacing ratio, *i.e.*, the distance apart divided by the height of suspension, is 4, which accords with the latest and most satisfactory practice, whilst the inequality ratio, *i.e.*, the maximum illumination divided by the minimum illumination, is only 3.2.

The General Electric Co. has introduced a smaller size of this lantern, possessing all the advantages of its larger prototype, which is particularly suitable for situations where a smaller light source is desired.

British Works in Italy.—The Rome correspondent of the *Financial Times* states that Sir Glyn West, chairman of Sir W. G. Armstrong Whitworth & Co., has recently made a tour of inspection of the company's works at Pozzuoli, near Naples. These works were founded a generation ago for the purpose of supplying the Italian Government with armaments. It has now been decided to reorganise and adapt the works for general industrial purposes. In certain lines of goods it will be possible, it is believed, to compete successfully with the big firms in the north of Italy, and in the south of Italy, which is on the eve of an important revival. Under the new organisation, Count Pecori Giraldi, chairman of the Italian company, will take charge of the Roman office, and Mr. Trevelyan has been appointed to manage the business at Pozzuoli. Mr. Walker will be in charge of the workshops. Mr. Humphrey Noble, who has been in Italy for the past 18 months, has been promoted to Manchester.

The Purification of Turbine Oil.

The Bowser Continuous By-pass System.

THE importance of getting the best out of lubricating oil and maintaining its efficiency as long as possible needs no emphasis; turbines may run on load for weeks without stopping, and reliability of the oil service is vital to continuity of operation. The conditions are severe, for the oil is exposed to high temperatures, and lubricates shafts running at high speeds, hence it is very liable to oxidisation and the formation of sludge.

To ensure that in these circumstances the oil shall be kept clean and pure, Messrs. S. F. Bowser & Co., Inc., have developed a method of continuously removing from it all impurities without interruption of service, under the name of the "continuous by-pass" system, which has been in use for some years in the United States with satisfactory results. The general lay-out of the apparatus is shown in fig. 1, for a single turbine, but a number of turbines may be dealt with by suitably modifying the plant. On this system the oil is kept flowing through purifying apparatus at a rate of about 20 per cent. of the whole quantity in the turbine oil reservoir per hour, returning after purification to the turbine. A "sight overflow" is connected to the turbine, enabling the flow of oil to be observed and ensuring that the level of the oil in the reservoir shall not vary; the discharge from the oil-filter pump is above this level, so that a failure of the pump cannot lower the oil-level. From the overflow the oil is piped to the filter, where all large solids are screened out, and then passes through a precipitation compartment, where sludge, water, air, &c., are further removed. The oil is spread out in layers over the trays, and the velocity of flow is made very low, to promote precipitation. The trays are deep, and need not be cleaned frequently. Separated water is by-passed directly to the bottom of the precipitating compartment, without further contact with the oil, and is automatically ejected through an adjustable overflow pipe, which is always water-sealed.

From the precipitation compartment the oil flows into the filtering compartment, which contains a number of non-collapsible filtering units, each consisting of sheets of heavily galvanised wire screen secured to a rigid metal frame. The edges of this frame are smooth, and it is covered with filter cloth, made in the shape of bags, which can be easily slid on and off. The oil passes from the outside to the inside of the filtering units and then out through nozzles projecting through the wall of the filtering compartment to the clean-oil compartment.

The filter units are so arranged that the filtering cloth is in a vertical position; the slime and sediment which collect on the outside of the cloth continually work towards the bottom and drop off, thus automatically tending to keep the surface clean.

The space in the bottom of the filter under the filtration compartment and at the sides of it forms a clean-oil reservoir, from which the pump draws the oil for return to the turbine.

Once a week all the oil in the turbine is run into the empty compartment of a 2-compartment storage or precipitation tank and allowed to settle and rest. The turbine base is then filled with the clarified oil that has been settling for a week in the other compartment of the tank. Each compartment has a floating suction.

According to an article in the *General Electric Review*, a turbine of 6,000 kW which had been running almost continuously for several years with oil-purifying plant of this type, in Wisconsin, showed the following results:—

	New oil.	Oil used 2½ years.
Specific gravity, deg. ...	27.8	27.6
Flash point, deg. F. ...	322	324
Viscosity at 100° F. ...	138	149
Acidity, per cent.	—	0.25

Fig. 4 shows an installation at the Dock Road power station of the Corporation of Cape Town, where it serves a 7,500-kW Metropolitan-Vickers turbine; four other installations are in use in this power station, and the makers inform us that since its introduction the system has been applied to about 1,500 turbines in all parts of the world. For the drawings here reproduced we are indebted to *Power*.

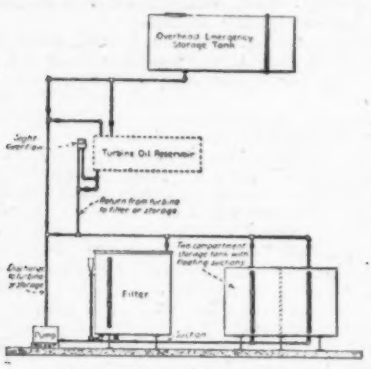
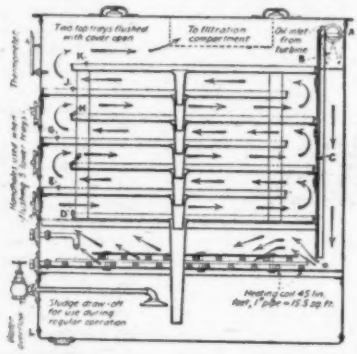


Fig. 1.—Lay-out for one Turbine.


Two top trays flushed with cover open
To filtration compartment
Oil inlet from turbine
Thermometer
Sludge draw-off for use during regular operation
Heating coil 45 lin. feet, 1" pipe = 15.5 sq. ft.

Oil flows into the filter at A, through screen B, down behind the curtain wall C, beneath the bottom tray D, then to and fro over trays E, F, G, H, J, and K. The water and most of the sludge drop down the central interconnecting tubes to the bottom of the filter. The water is automatically ejected at the overflow L.

Fig. 2.—Section Through Precipitation Compartment.

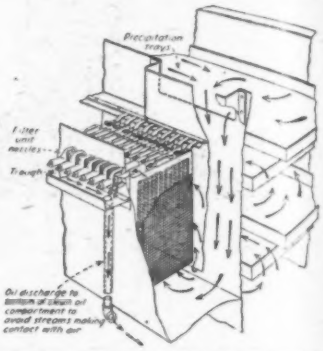

Precipitation trays
Filter unit nozzles
Trough
Oil discharge to bottom of clean oil compartment to avoid streams making contact with air

Fig. 3.—Path of Oil from Precipitation Compartment, trough Filter Units, to Clean-oil Compartment.

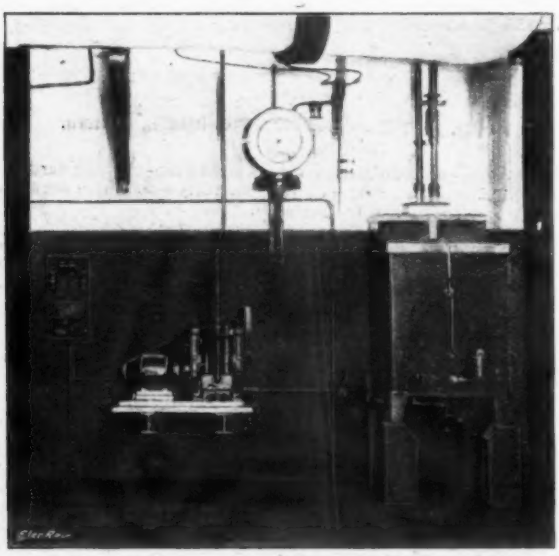


Fig. 4.—Installation at Cape Town Electricity Works.

The Prevention of Mining Accidents.—PRIZE COMPETITION.—Last year a competition was instituted by the proprietors of the *Colliery Guardian* for practical suggestions tending to greater safety in haulage operations in coal mines; this competition resulted in useful suggestions being received from workmen in every one of the British coalfields. Encouraged by this success, they have decided to promote a second competition, in which prizes of ten and five guineas respectively will be given for the best suggestions for preventing accidents due to falls of ground in mines. It is proposed to restrict the competition to working miners and officials. All entries must reach the *Colliery Guardian* not later than July 1st, 1924.

The Trade of Holland.

TRADE conditions in Holland are improving, and will be better still when commerce and production become normal again in the Ruhr. The Commercial Secretary at The Hague (Mr. B. V. Laming), in his report* to February, 1924, points out that the French occupation of the most important section of the Dutch Hinterland has been detrimental, in the first place, to the transport trade, and consequently Holland's two principal ports have suffered considerably. Secondly, the detrimental influence has been felt in the export trade of Dutch agricultural produce.

Mr. Laming describes the various measures of economy which the Government is introducing. The tariff will be revised, but only in a fiscal sense and not in a protective sense. He gives some interesting figures showing the effect of the occupation of the Ruhr on Holland's import trade in metallurgical products. It was responsible for a change in the sources of crude iron, such as pig iron, hematite, &c:—

	1922. Weights in 1,000's of tons.	1923. Weights in 1,000's of tons.	1922. Values in millions of florins.	1923. Values in millions of florins.
Totals	32.5	42.7	1.9	2.9
From—				
Germany	12.9	2.6	0.78	0.19
Belgium	9.5	16.1	0.54	1.07
Great Britain ...	5.5	15.3	0.38	1.12

Regarding half-finished products, such as ingots and billets, there was a general decrease. British imports, however, remained at the same level. The demand for rough castings caused an increase of 4,000 tons, the chief gainer being Belgium; prices, however, were relatively low. The improvement in British imports, although slight, was at relatively higher prices. Stagnation in the shipbuilding industry affected the total importation of iron and steel plates, which again bears evident marks of the occupation of the Ruhr, the principal supplies being now drawn from Great Britain and Belgium, in the latter case at decreased prices. Those obtained by Great Britain and Germany remained near last year's level.

It is worth noting, Mr. Laming continues, that French ironmasters have apparently not been successful in this market, whereas Belgium has acquired a larger number of orders, but it is doubtful whether these will show a profit in gold values. British imports of iron girders and rails remained negligible, but the total imports of the former increased and for the latter there was a much smaller demand. Imports of wheels and axles similarly decreased, Belgium securing more orders at the cost of Germany. Germany remained the principal source of supply of tubes. Anchors and chains were practically in the same demand as in the previous year, British imports making slight headway.

Bolts, nails, &c., decreased generally, but imports from Great Britain were larger. Iron and steel drawn wire was in greater demand, of which increase Great Britain was able to book a fair share. There was a general decrease of importation of steel cables, but imports from Great Britain increased. Stoves, including gas and electric, were again practically exclusively obtained from Germany and Belgium. Tinned and galvanised ironware was less in demand, but a larger quantity emanated from Great Britain than in the previous year.

The report mentions that the electrification of part of the railway line between Amsterdam and Rotterdam has been continued. The first portion of the line on which trials are to be conducted is that between Leyden and The Hague. In order to meet the competition of numerous motor omnibus services, the railway and tramway companies are running motor coaches on their permanent ways.

Trade Statistics.

The following statement, showing the imports and exports of electrical and similar goods into and from Holland during the year 1923, is compiled from the recently-issued statistics. The figures for 1922 are added for purposes of comparison and notes of any increases or decreases are given.

IMPORTS.

	1922. Florins.	1923. Florins.	Inc. or Dec. Florins.
Electric generators, motors, transformers and rotary converters.—			
Total	7,166,000	6,010,000	−1,156,000
From Germany	4,786,000	4,226,000	− 560,000
,, Great Britain ...	577,000	535,000	− 42,000
,, Switzerland	912,000	347,000	− 565,000
,, Belgium	362,000	355,000	− 7,000
Wireless apparatus.—			
Total	676,000	757,000	+ 81,000
From Germany	417,000	484,000	+ 67,000
,, Great Britain ...	121,000	135,000	+ 14,000
Telegraph and telephone apparatus.—			
Total	6,350,000	5,182,000	−1,168,000
From Germany	2,834,000	2,102,000	− 732,000
,, Belgium	2,247,000	1,477,000	− 770,000
Other electrical apparatus and instruments.—			
Total	5,465,000	4,980,000	− 485,000
From Germany	4,119,000	3,822,000	− 297,000
,, Sweden	554,000	400,000	− 154,000
,, Great Britain ...	203,000	297,000	+ 94,000
Steam boilers.—			
Total	3,413,000	2,528,000	− 885,000
From Germany	1,445,000	462,000	− 983,000
,, Great Britain ...	1,760,000	1,745,000	− 15,000
Portable electric sets.—			
Total	29,000	6,000	− 23,000
Telephone cable.—			
Total	1,967,000	1,876,000	− 91,000
From Germany	1,703,000	1,598,000	− 105,000
,, Great Britain ...	231,000	*	*
Other paper-insulated lead-covered cable.—			
Total	2,999,000	1,800,000	−1,199,000
From Germany	2,771,000	1,662,000	−1,109,000
,, Great Britain ...	214,000	*	*
Other lead-covered cable.—			
Total	1,431,000	1,143,000	− 288,000
From Germany	1,210,000	1,052,000	− 158,000
Rubber-insulated copper wire or cable.—			
Total	1,196,000	1,230,000	+ 34,000
From Germany	1,017,000	775,000	− 242,000
Copper wire or cable insulated other than with rubber.—			
Total	227,000	224,000	− 3,000
Steam engines and turbines.—			
Total	5,213,000	2,127,000	−3,086,000
From Germany	2,075,000	1,135,000	− 940,000
,, Great Britain ...	2,511,000	422,000	−2,089,000

EXPORTS.

	1922. Florins.	1923. Florins.	Inc. or Dec. Florins.
Electric generators, motors, transformers and rotary converters.—			
Total	2,114,000	1,909,000	− 205,000
To Germany	444,000	153,000	− 291,000
,, Belgium	721,000	588,000	− 133,000
,, Dutch East Indies ...	412,000	296,000	− 116,000
,, Spain	147,000	60,000	− 87,000
Wireless apparatus.—			
Total	335,000	254,000	− 81,000
To Germany	48,000	*	*
,, Great Britain	72,000	*	*
,, Dutch East Indies ...	204,000	*	*
Telegraph and telephone apparatus.—			
Total	442,000	326,000	− 116,000
To Great Britain	161,000	153,000	− 8,000
,, Dutch East Indies ...	184,000	85,000	− 99,000
Other electric apparatus and instruments.—			
Total	766,000	708,000	− 58,000
To Germany	124,000	41,000	− 83,000
,, Belgium	66,000	93,000	+ 27,000
,, Dutch East Indies ...	452,000	399,000	− 53,000
,, Great Britain ...	*	75,000	*
Steam boilers.—			
Total	1,709,000	944,000	− 765,000
To Dutch East Indies ...	1,492,000	810,000	− 682,000
Insulated copper wire and cable.—			
Total	2,085,000	2,512,000	+ 427,000
To Belgium	353,000	205,000	− 48,000
,, Great Britain	363,000	434,000	+ 71,000
,, Dutch East Indies ...	605,000	413,000	− 192,000
,, Norway	136,000	52,000	− 84,000
,, Denmark	160,000	205,000	+ 45,000
,, China	*	126,000	*
Metallic filament lamps.—			
Total	22,313,000	25,816,000	+3,503,000
To Belgium	1,350,000	1,450,000	+ 100,000
,, Great Britain	1,134,000	1,232,000	+ 98,000
,, France	5,109,000	3,973,000	−1,136,000
,, Italy	2,665,000	2,142,000	− 523,000
,, Spain	918,000	918,000	—
,, Argentina	2,723,000	4,611,000	+1,888,000
,, Brazil	959,000	987,000	+ 28,000
,, Canada	893,000	1,030,000	+ 137,000
,, Australia	1,263,000	1,208,000	− 55,000
,, Dutch East Indies ...	260,000	421,000	+ 161,000

*Department of Overseas Trade. Price 2s.

(Florin or Guilder=about 1s. 8d.)

* Not separately distinguished.

Legal.

British Thomson-Houston Litigation.

IN the Chancery Division on May 2nd, Mr. Trevor Watson, on behalf of the British Thomson-Houston Company, Ltd., moved *ex parte* for an injunction to restrain T. W. Crawford from infringing plaintiffs' patent in connection with the leading-in wire in electric lamps.

His LORDSHIP granted an injunction *ex parte* for a week.

Mr. WATSON also moved on behalf of the same plaintiffs for an injunction against Pollard & Smith to restrain infringement of patent.

His LORDSHIP said he had received a letter from Pollard and Smith enclosing copy of a letter written by them to the plaintiffs. If the contents of the letter were true he was rather sorry for those people. They said they were so badly off that they could not afford to come to London and that an order for costs would ruin them.

MR. WATSON said that his clients had no desire to prosecute people who were in that position, but they were obliged to protect their own interests. It was an extraordinary fact that these infringing lamps were being imported into this country at the rate of hundreds of thousands, and the plaintiffs had spent enormous sums of money advertising the fact, and the smallest dealer in the United Kingdom knew perfectly well that it was dangerous to deal in these lamps without being certain that they came from the people authorised to deal with them.

His LORDSHIP said he had no alternative but to give the plaintiffs the injunction asked for until the hearing of the action or further order, but the order would not be drawn up for a week so as to give the plaintiffs an opportunity of seeing the defendants and finding out whether they would consent to a final judgment to save further expense. He asked whether the plaintiffs were claiming for damages.

MR. WATSON said he could not waive his right to an inquiry as to damages; but if the defendants would make an affidavit as to the number of lamps they had sold so as to give the plaintiffs an opportunity of testing the statement, then he would not press for damages.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

THE hearing of appeal of the defendants in this case against the decision of Mr. Justice Russell was concluded in the Court of Appeal on May 2nd. Their Lordships reserved judgment.

British Thomson-Houston Co., Ltd., v. Charlesworth, Peebles & Co.

A PETITION was recently presented by the appellants to the House of Lords in this action (Charlesworth, Peebles & Co.), asking that the time for lodging their printed case and appendix and setting down the case for hearing, might be extended to June 16th. The agents for the respondents consented and the petition was ordered as prayed.

Tomlinson-Lee v. Hickmott.

A THREE-DAYS' hearing was begun by Mr. Justice Branson and a common jury on April 30th in the King's Bench Division of an electrical engineer's slander suit brought by Mr. Harry Tomlinson-Lee, of 42, King's Road, Wimbledon, against Mr. Augustus Wm. Hickmott, of 52, Merton Road, Wimbledon, alleging that Mr. Hickmott made certain statements about the plaintiff during canvassing in a local Council by-election and in a letter which defendant on March 1st, 1922, read to the Wimbledon Borough Council.

For the plaintiff appeared Sir Henry Maddocks, K.C., and Mr. Jacobs; for the defendant, Mr. Compston, K.C., and Mr. Eddy.

Plaintiff was dismissed from the post of chief electrical engineer to the borough, and the letter addressed to the Mayor, Mr. Shirl Mussell, by the defendant as chairman of the Electricity Committee said: "You think I, on behalf of my committee, ought to state to the Council to-morrow why we thought a change of management should be made. I should have thought that what I said on January 31st at a meeting of the Wimbledon Town Council would have satisfied most people, but with deference to your wish I am prepared to say, after consulting my committee, that the simple explanation is that they have lost confidence in Mr. Lee and, having come to that conclusion, there is only one course to take. The loss of confidence is not the result of occurrences during the last month or year. The plain fact is that for some years past Mr. Lee's conduct has not been satisfactory to his committee. In August, 1919, they intimated to him in writing their dissatisfaction, and suggested that he should amend his ways. He was asked, among other things, to economise in the undertaking, to give the committee information, and to be more courteous and patient with members of the committee and members of the public. The pity is he did not respond as it was hoped he would. The appointment by the Council of consulting engineers in January, 1921, was another indication to Mr. Lee that the committee had not full confidence in him. In my judgment, and in that of my colleagues, Mr. Lee did not show any desire to work cordially with his committee or to co-operate with them in what he knew we had much at heart—the greatest economy possible in the working of the undertaking. Mr. Lee's temperament may account for this, but whatever the cause is, there is no doubt of the fact that he and the committee have not worked harmoniously. Under such circumstances, what would any employer do?"

Sir Henry Maddocks having opened the case, plaintiff gave evidence. Under cross-examination by Mr. Compston he agreed that about June, 1923, the Metropolitan-Vickers Electrical Co., Ltd., Westminster, offered him an appointment at a salary, with commission, amounting to £800, but with the unacceptable condition that he dropped this action. He had brought three actions for slander or libel in connection with this matter. Against the Mayor, Alderman Mussell he obtained a verdict of £250, and against Ald. Peel a verdict of £120, and an action he brought against the Corporation for wrongful dismissal and insufficient notice was compromised by payment of six months' salary in lieu of notice.

Mr. COMPSTON: You have had £400 from the Corporation in lieu of notice and £375 damages from two members of the Corporation, and another action is pending against another member of the Corporation.—Yes.

Was your object to vindicate your character or to make money?—It was certainly not to make money, but to re-establish my professional career, which had been utterly taken away from me.

Mr. COMPSTON said that plaintiff's solicitors had written to defendant's solicitors stating that, as plaintiff had now vindicated his character, he would consent to the withdrawal of the action on payment of £100. The reply intimated that Mr. Hickmott's statement was prepared not by him, but by counsel, and he was willing not to pay damages, but that each party should pay his own costs.

Mr. LEE agreed that that was not acceptable to himself.

Mr. W. A. BEADELL, of Wimbledon, declared that Mr. Hickmott came to his house canvassing for a municipal by-election and said Mr. Lee was discharged for drunkenness.

Cross-examined: Witness first mentioned this incident to anybody six or eight weeks ago.

Witness's son, A. W. Beadell, corroborated as to the conversation.

Mr. JAMES TEMPLE, of 45, Southdowne Road, said that two people called on him, in 1922, soliciting a vote. He knew them now as Mr. Hickmott and Mr. Peel. Mr. Hickmott asked as to the dismissal, said witness thought that Mr. Lee's manners were not suitable for a man holding the position he did.

Mr. HICKMOTT, in giving evidence, said he was a grocer and had lived at Wimbledon 15 years. For a year before he became chairman of the Electricity Committee, in 1921, Mr. Lee met the committee every month, and there was never a meeting without a terrific lot of bickering and quarrelling the whole time. The committee regarded his scheme as wild. His recommendation of a named engineer to give an opinion on a part of the scheme for £25 was not accepted. It was untrue to say that when witness became chairman a persecution of Mr. Lee began. He had never felt any dislike or malice towards plaintiff, and was not from the first aggressive towards him. When witness said the undertaking was "rottenly managed" he said it in Mr. Lee's presence. Witness's visits to the works had been regular every Monday and Wednesday to this day, because he believed the undertaking could be made very successful. He did not take the management out of plaintiff's hands. The letter he wrote to the Mayor was drafted by the Town Clerk as far as he knew, who told him he had submitted it to counsel's opinion. Three weeks after witness became chairman, he told Mr. Lee he should not continue as chairman unless the committee decided whether they would accept Messrs. Sparks's advice, decided to go on without bickering, no real business had been done in the whole of the preceding 12 months because of it—and decided as to whether they were satisfied with the management. He notified Mr. Lee of the informal committee meeting. Witness canvassed on even numbers in Southdowne Road, and Mr. Beadell and Mr. Temple lived at odd numbers. He had no recollection of ever having seen any of the Beadells, and he certainly never said Mr. Lee was discharged for drunkenness. Such a statement would have been a lie. He did introduce Mr. Peel to Mr. Temple, and then stood aside. He did not say the car had been outside a public-house. He had never seen the car outside a public-house or Mr. Lee inside. They had been warned, and were very careful what they said on that canvass. He always gave the same answer. He regarded the questions as traps set, and nothing was said that could be construed to do Mr. Lee any harm. He never went to Mr. Beadell's house, and he never used any of the words complained of about Mr. Lee.

In the course of cross-examination, witness said he never asked for the letter written to the Mayor to be written. He did not know it had been drafted till it was drafted by the Town Clerk and submitted to counsel. It was submitted to the committee, and he signed it on behalf of the committee. It was the committee's letter. The conversation in which it was said that he declared if Mr. Lee did not like his intervention he could go never took place.

On Friday, May 2nd, Mr. Hickmott was further cross-examined.

MR. ALFRED STEELE SHELDON, consulting town clerk and late town clerk of Wimbledon was called, and said he drafted the letter which Mr. Hickmott read to the Council. It was not drafted in any way upon defendant's instructions. It was practically witness's letter. He consulted counsel upon the letter and on the question whether if malice could be established in any member of the Corporation, the Corporation would be liable in damages on the ground of wrongful dismissal. If the letter was posted privilege could not be claimed for it; if it was read in the Council privilege could.

MR. FREDERICK WM. DAFFEN, a member of the Council, said it was not true to say that things had been running smoothly before Mr. Hickmott's appointment as chairman of the committee. He saw no personal hostility in Mr. Hickmott to the plaintiff; on the other hand, Mr. Hickmott said he did not wish for bother or trouble; all he cared for was to have the concern run for the benefit of the town.

MR. SHIRL MUSSELL, mayor in the year of plaintiff's dismissal, stated that the relations with Mr. Lee were not harmonious before Mr. Hickmott became chairman. Witness had already resigned the vice-chairmanship because he had known the electrical engineer many years and he did not like the attitude he was adopting to his committee. He felt there would be trouble. Witness was defendant in an action brought against him by Mr. Lee before the Lord Chief Justice.

ALDERMAN ABBOTT also declared that it could not be said that things had been running smoothly before Mr. Hickmott became chairman. Mr. Lee was a Yorkshireman and was impatient when technical questions were put to him by members. Witness thought his manner rude, but he himself understood and took no notice. He seemed irritable and replied in a loud voice. There was always that strained feeling. Neither Mr. Hickmott nor other members had any personal animosity towards Mr. Hickmott.

COUNCILLOR PENMAN also gave evidence.

When the jury retired the judge gave them four questions to answer. When they had been absent over an hour and a half he called them in and told them that upon any point on which they had difficulty they had to remember plaintiff must prove his case, and if on any matter they could not say he had done so their verdict must be for the defendant on that head. The questions were:—

(1) Does the letter convey a defamatory meaning?
(2) Was defendant actuated by malice in reading it?
(3) Did he utter the slander alleged by the Beadells? and
(4) Damages.

After being out altogether two hours and ten minutes, the jury returned with the announcement that they could not agree. They answered the first two questions:

(1) Yes.
(2) No, and on
(3) Disagreed.

A juror rose and said he could not find sufficient evidence to answer "Yes" to (3).

The judge said question 4 did not now arise and dismissed the jury. At an earlier stage the judge asked if either party cared to accept a majority verdict, but neither seemed disposed to act on the suggestion.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

Trading Agreements.

I have read the article "Some Ill-Considered Aspects of Trading Agreements," published in your issue of April 18th, with great interest, but am unable to agree with many of the views expressed by "Just Bide a Wee."

I believe that trading agreements, if drawn up on the lines suggested in the "E.C.A. Trading Policy," published in the issue of the ELECTRICAL REVIEW for May 4th, 1923 (and obtainable from the E.C.A. Head Office), are for the general good of the industry.

In the pamphlet mentioned, definitions are given of wholesaler, contractor, and retailer, and it is admitted that at present overlapping cannot be absolutely avoided: is it good policy, however, for a manufacturer regularly to act as a contractor? He can hardly expect to get orders for his goods from a firm with which he is in competition.

"Just Bide a Wee" infers that the manufacturer must sell to the user at the same terms as the re-seller. One cannot very strongly object to the maker selling direct if the retailer will not, so long as the price obtained from the user is such as the re-seller could have sold at to the user with a reasonable profit; the contractor is very willing to sell any goods on which he can obtain a reasonable profit, but cannot be expected to support a manufacturer who does not protect him.

The question of service is most important, and I suggest that the contractor can give this more efficiently than the manufacturer, as he fixes and maintains installations and is able to recommend the most suitable article for each individual case, as he is not (as a rule) tied to a particular maker.

The figures showing the percentage of sales of motors to various sections are very interesting. It is probable, however, that sales, to the small user at any rate, could have been made more efficiently by the contractor, who is often driven to order from small motor makers instead of from the better-known firms so as to obtain the order at a profit.

The position to-day with regard to the factor is far from satisfactory, but this could be overcome if only those who carry substantial stocks for sale to the retailer were recognised.

I firmly believe that if the following prinicples were adopted, many of the troubles of our industry would disappear, to the advantage of all, and that as a further result the price to the user would be reduced:—

(1) That the price charged to the genuine re-seller for a similar order shall be such as will enable him to sell to the user with a reasonable profit.

(2) That a quantity discount or rebate be allowed to all purchasers, thus giving the large user better terms than the small re-seller and allowing the factor to get better terms than the retailer.

(3) That a discount for cash with order or monthly account be allowed, but that the terms be strictly enforced; this will certainly lead to greater financial stability and thus cause further capital to be invested in the electrical industry.

Some of the strongest associations of manufacturers (*e.g.*, C.M.A., E.L.M.A., N.A.R.M.), according to their published terms, agree to these principles, and if other associations will act on similar lines, I do not think "Just Bide a Wee" will have cause to criticise trade agreements so strongly in future.

Newcastle-on-Tyne, *April 28th*, 1924. **W. Cross**, M.I.E.E.

Referring to Mr. Armour's letter in your issue of the 2nd inst., criticising my article, as he is an official of the E.C.A. of S., it is conceivable that, from his point of view, the article may be "ill-advised and premature." From the point of view of the industry, however, I suggest that the contrary is only too true. There undoubtedly exists in the electrical trade to-day a decided tendency towards the formation of "rings" and mostly "price rings" at that. Who can deny it? There is, further, little doubt that the value of such rings to the community at large, and to the trade in particular, is a very debatable point, when *all* considerations are duly weighed in the balance. Indeed, the conclusion being forced on all is that the basic spirit of these agreements is of the "man, mind thyself" type. As an exponent of the honest application of free trade principle, I feel that an attempt is being made in the electrical industry to inaugurate a most unfair system of protection, and that in three most important aspects, *viz.*:

(*a*) The throttling of individuality, both technically and financially, by the attempted elimination of certain traders, notably the "no-oncost" man (*vide* the deliberate attempt to curtail reasonable cash terms), &c.

(*b*) The confining of the trade to a selected few, who, generally, commenced as "no-oncost" men and who now are suffering from the lack of the latter's modern business education (*e.g.*, where do we hear of the inauguration of an efficient costing system by contracting firms?)

(*c*) Just how much are such agreements within the *spirit* of that Statute referring to the Restriction of Trade?

Other very apparent aspects might be cited and in a progressive journal of this kind the discussion of the industry in *every* aspect is very necessary as an aid to the grasping of the proper perspective, for, immediately *individuality* is attacked and fettered in any industry, that industry declines. The life of the nation, also, depends on the life of the individual.

Clearly, the article has aroused interest, since Mr. Armour writes on behalf of others, who, it may be remarked, have not instructed him to refute any of the points raised therein. I sincerely hope that other correspondents will come forward with facts and figures on the basis suggested in the article and table their views on the question as a whole.

A copy of the report referred to by Mr. Armour was handed to me and the perusal of the same merely accelerated my desire to complete the article already commenced on a basis of a general survey of similar documents. Under these circumstances, it is but natural that this report could not be analysed in detail, the more so, as I believe that very many local contradictory opinions have already been publicly expressed regarding it. Obviously, such a report could hardly be taken as a satisfactory basis for an article.

I respect Mr. Armour's suggested meeting to discuss the matter, but as to whether I could satisfy his committee that such would redound to our mutual satisfaction, I am much in doubt. Recollections of previous similar meetings rather indicate the direct negative. In the meantime, therefore, I must apologise to you, gentlemen, for using up so much valuable space and I beg to

Just Bide a Wee.

May 3rd, 1924.

The A.C. Commutator Motor and the Engineer's Education.

The truth of Mr. Pensabene-Perez's contention, in your issue of the 25th instant, that there is a lack of knowledge of this type of motor will, no doubt, be substantiated by those who have attempted to interest operating and other engineers in this subject and in its allied one, *viz.*, the application of a.c. commutator machines to the excitation of induction motors for the purpose of power-factor improvement, &c.

This lack of knowledge is really due, as Mr. Pensabene-Perez suggests, to the scarcity of *suitable* literature, practically

all of which is to be found scattered through the American and continental electrotechnical Press and *Proceedings* of technical societies. Moreover, this literature treats the subject in a manner more suited to the needs of the designer and of those who have maintained in a state of freshness their knowledge of vector diagrams and the algebra of imaginary quantities; the result is that the study of this literature involves the expenditure of considerably more time than the busy engineer has at his disposal. The scanty literature available in this country fails to explain clearly—and from the *physical* standpoint—the fundamental properties of an a.c. rotor furnished with a commutator; vector diagrams and arithematical equations abound, but the average engineer is not interested in these and the question, the answer to which he vainly seeks is: Why is a commutator necessary? It is frequently forgotten that the popularity of the plain induction motor is largely due to the absence of a commutator, which is considered a troublesome adjunct, but without which it is impossible to effect power-factor improvement if rotating machinery is to be used for this purpose; the commutator of the d.c. exciter on synchronous motors and that on the a.c. exciter for connection to the rotors of induction motors are examples of this necessity, the reason of which is never explained in the text-books.

Perhaps Mr. Pensabene-Perez or some other expert will contribute to your columns a series of articles dealing with this subject from the *physical* standpoint and so pave the way to its better understanding.

Thomas Ellis.

London, *April 29th*, 1924.

I have read with interest the letter from Mr. Pensabene-Perez under the above heading in your issue of the 25th inst., and fully agree with his remarks regarding the slowness of development of the alternating-current commutator motor.

It is indeed difficult to understand the lack of appreciation of the excellent qualities inherent in such machines, and one is forced to conclude that the lack of knowledge observed by Mr. Pensabene-Perez on the part of operating engineers is in no small measure responsible for this state of affairs.

In the writer's opinion an extensive sphere of application is open to the commutator motor if only due attention be paid to its possibilities.

G. Windred.

London, *April 28th*, 1924.

Radio Valves.

In answer to the letter by "Valve" in your issue of April 25th, *re* the marking of radio valves or, in other ways supplying particulars of filament voltage, &c., I should like to point out that most of the leading makers are supplying the information required, either by printing it on the carton or by a paper slip on the cap of the valve.

The following makers have been doing this for some time: B.T.-H., Ediswan, Marconi-Osram, and (I believe) Mullards.

A Valve User.

April 28th, 1924.

Published Specifications.

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

27,096. "Control of electric switches." British Thomson-Houston Co., Ltd., and A. S. Fitzgerald. October 6th, 1922. (Cognate application 12,732/23.) (213,941.)

30,379. "Brake gear with special reference to railway and tramway vehicles." Cammell, Laird & Co., Ltd., and A. S. Bailey. November 7th, 1922. (213,943.)

1923.

396. "Electric cooking apparatus." H. Bohle. January 5th, 1923. (213,955.)

480. "Thermionic valve arrangements suitable for use in wireless telegraphy and telephony." G. Tipping, G. Derham, and J. W. Hall. January 5th, 1923. (213,957.)

551. "Electric switches." A. W. G. Tucker and Ferranti, Ltd. January 6th, 1923. (213,958.)

636. "Electric bell and similar push switches." O. T. Banks. January 8th, 1923. (213,965.)

641. "Microphone transmitters for gramophones." P. E. Davenport. January 8th, 1923. (Cognate application, 2,367/24, a divided application on 641/23.) (213,966.)

782. "Drives for paper-making machines and the like." British Thomson-Houston Co., Ltd. (General Electric Co.). January 9th, 1923. (213,972.)

853. "Electric hand-lamps." W. T. Coulson. January 10th, 1923. (213,974.)

876. "Electrical apparatus for generating ozone." J. McBlain. January 10th, 1923. (213,975.)

885. "Insulating means for high potential terminals, conductors, and the like." P. R. Coursey, and Dubilier Condenser Co. (1921), Ltd. January 10th, 1923. (213,978.)

888. "Magneto-electric machines." M.L. Magneto Syndicate, Ltd., and E. A. Watson. January 10th, 1923. (213,979.)

891. "Speed-controlling mechanism for paper-making or like machines." British Thomson-Houston Co., Ltd. (General Electric Co.). January 10th, 1923. (213,980.)

926. "Reflectors for electric lamps." F. T. O'Hanlon. January 11th, 1923. (213,982.)

1,075. "Controlling of elevators or lifts." A. C. H. Groom. January 12th, 1923. (213,989.)

1,127. "Variable electric condensers and their manufacture." W. W. Drury and Marconi's Wireless Telegraph Co., Ltd. January 13th, 1923. (213,992.)

1,231. "Telephone systems." Automatic Telephone Manufacturing Co. Ltd. April 17th, 1922. (196,245.)

1,357. "Interconnecting arrangements between groups of switches in automatic or semi-automatic telephone systems." Automatic Telephone Manufacturing Co., Ltd. (Automatic Electric Co.). January 15th, 1923. (214,000.)

1,573. "Selective systems applicable to type-printing, telegraphy, and to other purposes." L. Semat. June 30th, 1922. (200,055.)

1,636. "Motor head-lights." W. T. Coulson. January 18th, 1923. (214,002.)

2,055. "Wireless receiving apparatus." J. W. Barber. January 26th, 1923. (Cognate application, 4,617/23.) (214,005.)

2,079. "Signalling devices for tramway and like systems." L. H. Smith. January 23rd, 1923. (214,007.)

2,193. "Electric controllers." Electro-Mechanical Brake Co., Ltd., and M. J. Pattison. January 24th, 1923. (214,010.)

2,223. "Electrotherapeutic apparatus." M. Wolf. January 24th, 1923. (214,011.)

2,827. "Means for securing the cover of a ceiling rose or electric tumbler switch to the china or like base." J. Pownall. January 31st, 1923. (Cognate application, 2,828/23.) (214,018.)

2,915. "Electrolysers." Mather & Platt, Ltd., and S. F. Barclay. January 31st, 1923. (214,020.)

4,993. "Vacuum or electron discharge tube apparatus." S. Ruben. February 20th, 1923. (214,036.)

5,023. "Expanding carrier for electric accumulators, one or more tins of petrol, and the like." W. Whitehead. February 21st, 1923. (214,037.)

5,120. "Electric generating apparatus." British Thomson-Houston Co., Ltd. March 17th, 1922. (195,049.)

5,317. "Electric burglar alarms." H. Eisler and Rely-A-Bell Burglar and Fire Alarm Co., Ltd. February 23rd, 1923. (214,040.)

5,706. "Electric signalling systems." D. G. McCaa. May 2nd, 1922. (197,296.)

6,317. "Smelting and electrolyzing processes." R. Rodrian. March 3rd, 1922. (194,314.)

6,336. "Method of constructing an electrical cable." Western Electric Co., Ltd. (Western Electric Co. Inc.). March 5th, 1923. (214,053.)

6,892. "Electric heating elements." Benham & Sons, Ltd., and H. C. Barrett. March 9th, 1923. (214,058.)

11,125. "Electric vibratory devices." British Thomson-Houston Co., Ltd. August 24th, 1922. (202,956.)

11,285. "Arrangements for the supply of power to wireless transmitters." K. E. Edgeworth. April 26th, 1923. (214,089.)

11,722. "Loaded signalling conductors." Western Electric Co., Ltd. May 2nd, 1922. (197,331.)

11,961. "Control of electrically-propelled road vehicles." R. Garrett and Sons, Ltd., and A. E. Collins. May 3rd, 1923. (214,093.)

12,080. "Dynamo-electric machines." E. Graichen. May 4th, 1923. (Convention date not granted.) (197,339.)

12,128. "Electric fire-bars or elements." Falkirk Iron Co., Ltd., and A. R. Wood. May 5th, 1923. (214,094.)

13,931. "Electric incandescent lamps." A. Mullor. May 26th, 1923. (Convention date not granted.) (198,375.)

16,028. "Manufacture of electric incandescent lamps or the like." General Electric Co., Ltd. January 5th, 1923. (209,384.)

16,169. "Revolution counters." British Thomson-Houston Co., Ltd. (General Electric Co.). June 21st, 1923. (214,127.)

16,420. "Detectors for wireless receiving apparatus." L. Benson. June 25th, 1923. (Cognate application, 28,572/23.) (214,129.)

16,674. "Electric tube welding machines." E. Schroeder. June 27th, 1923. (214,130.)

17,585. "Safety devices for mine-cages, lifts, elevators and the like." O. Binon and C. Wautelet. July 13th, 1922. (200,813.)

18,433. "Terminals for electric current conductors such as rail bonds and the like." E. F. Fleet, F. Horler, and Westinghouse Brake & Saxby Signal Co., Ltd. July 17th, 1923. (214,139.)

18,900. "Sparking plugs." T. Morgan. July 21st, 1923. (214,141.)

19,001. "Apparatus for limiting the short-circuit current of direct-current dynamo-electric machines having a separate exciting dynamo." Akt. Ges. Brown, Boveri et Cie. August 28th, 1922. (202,966.)

20,586. "Insulators and methods of manufacturing the same." British Thomson-Houston Co., Ltd. (General Electric Co.). August 13th, 1923. (214,151.)

21,255. "Closure means for accumulators." Soc. des Accumulateurs Fixes et de Traction. September 6th, 1922. (203,670.)

25,673. "Vacuum tubes of the 'audion' type." F. Perl. October 7th, 1922. (Divided application on 205,038.) (205,512.)

27,877. "Voltage insulator especially suitable for electrical gas-purifiers." Lodge-Cottrell, Ltd. (Metallbank und Metallurgie Ges. Akt. Ges.). November 6th, 1923. (Addition to 202,539.) (214,170.)

29,257. "Method of and means of rectifying high-tension alternating current." Lodge-Cottrell, Ltd. (Metallbank und Metallurgie Ges. Akt. Ges.). November 20th, 1923. (214,174.)

29,295. "Manufacture of spiral filaments of refractory metals for electric incandescent lamps." General Electric Co., Ltd. May 17th, 1923. (214,175.)

29,497. "Oil-tanks for electric transformers or other electric apparatus." Sachsenwerk Licht-und Kraft-Akt.-Ges. and F. Haberle. November 22nd, 1923. (214,176.)

30,519. "Method of balancing telephone phantom lines for reducing overhearing." Felton & Guilleaume Carlswerk Akt. Ges. December 4th, 1922. (207,824.)

30,713. "Electric storage batteries." J. F. Monnot. March 17th, 1923. (Divided application on 7,762/23.) (214,177.)

32,220. "Recording of sounds." F. M. Johnson and A. Faucon. April 20th, 1923. (214,179.)

1924.

2,836. "Telephone receivers." L. A. L. Struxiano. February 10th, 1923. (211,129.)

A Great Spanish Enterprise.—It is reported from Madrid that the Spanish Directory has just published a decree deciding on the taking into consideration of a vast scheme of repair and improvement of the networks of railways, roads, and electricity supply in Spain, according to a project which has been prepared by a Spanish engineer, who is stated to have found the necessary financial co-operation in the United States and in England. The scheme also includes the construction of new railways between Hendaye-Algeciras, Madrid-Valencia, and Requena-Baezu-Alpujarra, of a total length of 1,550 miles, the exploitation of waterfalls and mines necessary for the use of electric traction on the railways, and the erection of blast furnaces and of works capable of utilising the mineral deposits of Spain. The railways and industries established under the project would become the property of the State, but would be worked by the Anglo-American syndicate, which would provide, it is said, a total of 3,000,000,000 pesetas on condition that the State would undertake to guarantee interest at the rate of 5 per cent., payable in gold.